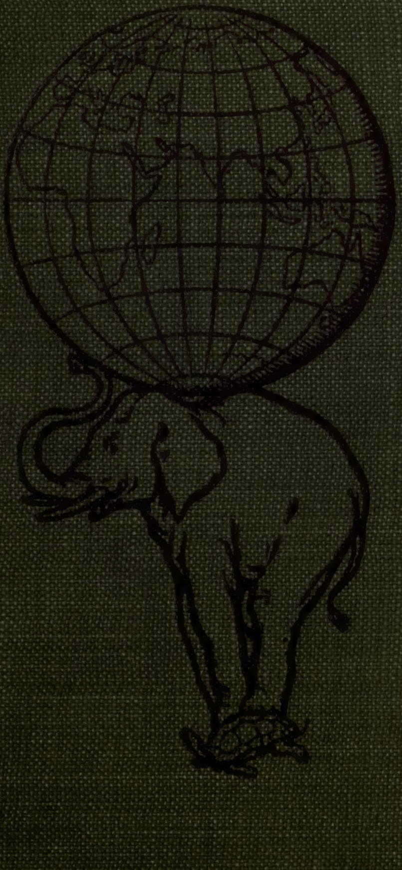
THE OLD RIDDLE AND THE NEWEST ANSWER



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The Lord St. Alban would say to some philosophers—"Gentlemen, nature is a labyrinth, in which the very haste you move with, will make you lose your way."

BACON, *Apophthegms.*

THE OLD RIDDLE AND THE NEWEST ANSWER

BY

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PREFACE

THE enemies of Science are not the philistines alone —if any still remain—who would muzzle or stifle her. More numerous and dangerous are those—professedly of her own household—who ascribe to her pretensions of which she herself knows nothing, and strive to make her responsible for a philosophy entirely beyond her scope. With this object efforts are assiduously made to popularize the idea that nothing in heaven or earth is beyond her ken, and that she has rendered all such beliefs impossible as alone can satisfy the deeper cravings of humanity. At the same time the very brilliance of her achievements is apt to dazzle our eyes, blinding them to the extremely narrow limits of the field in which she can operate, and making us rush to the conclusion that she has solved the riddle which from the beginning of time Nature has offered to every thinking mind,—or at least that what her search-light cannot illumine must for ever remain unknowable.

How far such assumptions are rational, it is the object of the present enquiry to examine by means of the evidence furnished by Science herself in her own regard.

I have to thank Mr. W. E. Darwin for permission to use the illustration of feathers of the Argus Pheasant from his illustrious father's *Descent of Man*, and for the loan of blocks for the purpose. Through the courtesy of Messrs. Macmillan I am allowed to copy a portion of the plate in the late Professor Huxley's *Lectures on Evolution*, illustrating his pedigree of the Horse. If I forbear to mention others who have kindly supplied me with information, it is only lest it might be supposed that they are anywise responsible for the use I have made of it. The design on the cover of the present volume I owe to my friend Mr. Paul Woodroffe.

J. G.

March 10, 1904.

PREFACE TO THE SECOND EDITION

In this edition, which has been thoroughly revised throughout, a few corrections have had to be made, especially in the Index, and in one or two instances alterations or additions have appeared advisable for the sake of clearness or accuracy of expression. Nothing has, however, as yet been brought to the author's notice which affects any substantial point in what he has written.

July 28, 1904.

PREFACE TO THE THIRD EDITION

THIS edition has again been thoroughly revised, and some new matter appended which bears on various points raised in the original volume, especially the establishment of the important group of the *Cycado-filices*, as affecting the succession of plant life on the earth, and recent evidence concerning the pedigree of the horse.

December 21, 1906.

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To Sum Up

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I

TO BEGIN AT THE BEGINNING

THAT the world as we know it had a beginning is a truth which there is no denying. Not only have philosophers always argued that it must be so: the researches of physical science assure us that it has been so in fact. Astronomy, says Professor Huxley,[1] "leads us to contemplate phenomena the very nature of which demonstrates that they must have had a beginning." The hypothesis that phenomena of Nature similar to those exhibited by the present world have always existed, the same authority assures us,[2] "is absolutely incompatible with such evidence as we have, which is of so plain and so simple a character that it is impossible in any way to escape from the conclusions which it forces upon us." This conclusion, physicists tell us, is inevitable when we study the laws by which the operations of Nature are governed, and as Professor Balfour Stewart writes,[3] we thus become "absolutely certain" that these operations cannot

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[1] *Collected Essays*, i. 35.

[2] *Lectures on Evolution*, Cheap Edition, p. 16.

[3] *Conservation of Energy*, § 210, p. 153.

have existed for ever, and that a time will come when they must cease. In like manner, a recent and competent witness to the conclusions of contemporary Science, lays down,[1] as one of the truths which her latest discoveries compel us to accept, that the world is not eternal, that the earth is cooling from a state of heat rendering life impossible, to one of physical exhaustion equally fatal to it. Accordingly "Life must have had a beginning and must come to an end,"—and our whole Solar System (he adds) must similarly have had a commencement, at a period not infinitely remote.

But, if the world had a beginning, what was there before it began? Something there must have been, and something which had the power of producing it. Had there ever been nothing, there could never have been anything, for, *Ex nihilo nihil fit*. That nothing should turn into something is an idea which the mind refuses to entertain. Nor is the case any better even if we suppose that matter had no beginning, that it has existed for ever as we know it now, and that at first there was nothing else. For if so, whence have all these things arisen which, according to all observation and experiment, matter cannot produce, as, organic life, sensitive life, consciousness, reason, moral goodness? Had matter been always what it now is, and had there been no source beyond matter whence the power of producing all these things could be derived, they could never have been produced at all, or else they would

[1] F. W. Hutton, F.R.S., *The Lesson of Evolution* (1902), pp. 9–11.

have come into being without a cause. It would be like a milestone growing into an apple-tree, or a mountain spontaneously giving birth to a mouse.

We are therefore compelled by common-sense to ask when we consider Nature, What is the force or power at the back of her, which first set her going, and whence she draws the capability of performing the operations which we find her performing every day; that force or power which must be the ultimate origin of everything that is in the world? This is the great fundamental problem which the student of Nature has to face, and beside it all others fade into insignificance. It is with this that we are now engaged. We have to ask how our reason bids us answer it, and the first question which arises naturally is, What light is thrown on the subject by modern Science, of whose achievements we are all so justly proud?

II

REASON AND SCIENCE

In studying a question such as this, we must commence by being determined, on the one hand to accept nothing as true but what our reason warrants us in believing, and on the other hand to follow the guidance of reason as far as, rightly used, it will lead us. The principle formulated[1] by Professor Huxley, as the foundation-stone of what he termed "Agnosticism," is that which must needs be adopted, and as a matter of fact has ever been adopted, by rational men.

Positively—in matters of the intellect follow your reason as far as it will take you, without regard to any other consideration. And negatively—in matters of the intellect do not pretend that conclusions are certain which are not demonstrated or demonstrable.

But to justify the confidence which we thus repose in it we must obviously be careful to use our reason aright, and not to attribute to it any conclusions which it does not really sanction. It is this right

[1] *Nineteenth Century*, February, 1889. p. 173.

use of reason that is specially claimed for modern "Science,"[1] which, as we are again assured by Professor Huxley, is only another name for sound reasoning—"*Science*," he declares,[2] "*is, I believe, nothing but trained and organized common-sense.*[3] . . . The man of science, in fact, simply uses with scrupu-

[1] This term is now applied almost exclusively to *physical science*, or that whose province is the observation of phenomena and inferences directly deducible from them. To avoid confusion, this sense of the word "Science" will be here adopted: it is nevertheless objectionable inasmuch as it implies that—as Professor Huxley following Hume would have it—sound knowledge is restricted, outside the field of mathematics, to "experimental reasoning concerning matter of fact and existence." But although all premisses or data of inference come to us first through the gates of sense, there is much, beyond the limits within which sensible experience is confined, to a knowledge of which inference can lead us, and of which we become certain before experience can verify what we have thus learnt. Thus a chipped flint or a fragment of pottery is universally recognized as evidencing the work of man: a single page of Virgil would suffice—apart from all other information—to prove its author to have been both a poet and a scholar: the shipwrecked mariner cast on an unknown shore argued soundly from the sight of a gibbet that he had reached a civilized land ruled by law. But more than this, Science herself proceeds on this principle to the recognition not only of forces, the character of which is known by previous experience, but of others concerning which she knows nothing at all, except through the very effects from which she argues. Thus, as all bodies left free are found to draw towards one another in a certain mode, it is concluded with absolute confidence that there is a force making them do so, although this is in itself utterly imperceptible, and is known only by the way in which bodies behave under what must be its influence. Yet, who questions the existence of Gravitation? In like manner, the phenomena of light force us to admit the existence of the Ether, as the medium through which its waves are transmitted. Yet, we are compelled to attribute to this medium qualities apparently so incompatible that, as the late Lord Salisbury said, Ether remains, "a half discovered entity." But little as we can realize its nature, we have no doubt that such a medium exists.

[2] "Value of the Natural History Sciences" (*Lay Sermons*), p. 75.

[3] Italics his.

lous exactness, the methods which we all, habitually and at every moment, use carelessly."

There can be no sort of question that so long as men of science really act thus, and confine themselves to the treatment of matters in regard of which they can claim special knowledge, common sense bids us listen to them with respect, and even with submission. But the same common sense requires that we should satisfy ourselves that they truly deserve the character assigned them, and pretend to no knowledge on the score of Science but what their scientific methods are competent to acquire. When they step beyond this their own proper domain, whatever weight may be given to their opinions upon other grounds, they cease to speak in the name of Science.

What then, we must ask, is the province of Science, and what are her methods?

"Science," always understanding by the term physical or experimental Science, deals with the universe so far as it is known to us through our senses. The universe known thus we call "Nature," and the whole stock in trade of Science is the examination and verification of natural phenomena, with such inferences therefrom as ascertained facts legitimately suggest. From careful and trustworthy observation she can learn what are called the "Laws of Nature," that is to say the manner in which the various elements and forces of the universe are found constantly to act, in given circumstances; she can, to some extent, discover the chain of causes

and effects, or more properly of conditions and consequences, through which natural operations are carried on. She can even construct hypotheses as to what she cannot directly observe, namely, the nature of substances and forces; and such hypotheses are justified in proportion as they are found to tally with facts. If constantly thus justified, they are styled theories, and come to be practically assumed as established truths. But it must ever be remembered that Science can take no step in advance which is not based on fact, and that when facts are not forthcoming for its support an hypothesis or a theory has no scientific value.

Bearing this in mind, we will proceed to enquire what Science has to tell us regarding the origin of the world, and the manner in which it has come to be what it is.

III

" EVOLUTION "

We are constantly assured that Science compels us to believe in " Evolution," and that in this doctrine is to be found the explanation of the universe whereof we are in quest. We must however in the first place make sure that we understand what " Evolution " means, and if we look into the question, it speedily appears that the term is very differently understood by those who use it.

Some who style themselves " Evolutionists " mean only that, as a matter of established fact, the organic world, the world of life, whether animal or vegetable, has been brought to its present condition by *genetic* development of one species from another, in the natural course of descent and through the operation of natural laws ; and that as we see plants and animals of the same kind propagated one from another at the present day, so in the course of long ages the lower and simpler forms of life have given birth to the higher and more complex.

Others again do not limit this process to organic creatures, and believe that from first to last, the

whole world, inorganic and organic alike, has resulted from the action of forces such as those with which Science deals; and that life has thus arisen in purely natural course out of non-living matter, the universe in its original condition having been constituted as a vast machine which was bound to produce all that has since arisen.

In either of the above senses—of which the second obviously includes the first,—"Evolution" is understood as no more than a *process* which is said to have occurred. But there is a more extreme school which takes "Evolution" for much more, namely for a power, principle, or "law," which both governs and accounts for everything, and requires no further cause beyond itself.

If this paramount "Law of Evolution" can be established, there is clearly an end of our enquiry, for here is the ultimate explanation of everything which we are seeking. But what has Science to say concerning it?

IV

"THE LAW OF EVOLUTION"

THAT there is a self-existing and self-sufficing "Law of Evolution" to which everything in the world must be ascribed, is the doctrine of those Evolutionists who are most active in propagating their creed and who most loudly proclaim that it alone is scientific. The great leader and prophet of this school, Professor Ernst Haeckel, assures us [1] that he gives expression,

> to that rational view of the world which is being forced upon us with such logical rigour by the modern advancements in our knowledge of nature as a unity, a view in reality held by almost all unprejudiced and thinking men of science, although but few have the courage (or the need) to declare it openly.

The plain and rational conclusion thus exhibited is, he tells us,[2] the special glory of modern research.

> It is true [he writes] that there were philosophers who

[1] *Confession of Faith of a Man of Science*, English translation, 1903, Preface, p. vii.

[2] *Riddle of the Universe*, Cheap English Edition, p. 2.

spoke of the evolution of things a thousand years ago; but the recognition that such a law dominates the entire universe, and that the world is nothing else than an eternal "evolution of substance," is a fruit of the nineteenth century.

So far as concerns the world which we actually inhabit, its first beginning, we must, he tells us, suppose[1] to have been a vast nebula of infinitely attenuated and light material, rotating upon its own axis.[2]

Given this first beginning of the cosmogonic movement, it is easy, on mathematical principles, to deduce and mathematically establish the further phenomena of the foundation of the cosmic bodies, the separation of the planets, and so forth.

Nor are we to suppose that the beginning of this particular process was in any true sense a beginning at all. Evolutionary philosophy such as Professor Haeckel's, necessarily teaches that beginnings and endings succeed one another everlastingly, one world-system arising phœnix-like from the ashes of another.

The nebular hypothesis above described has recently [we are told][3] been strongly confirmed and enlarged by the theory that this cosmogonic process did not simply

1 *Ibid.*, p. 85.

2 And also, it should be added, travelling bodily through space with a movement of "translation."

3 *Ibid.*

take place once, but is periodically repeated. While new cosmic bodies arise and develop, out of rotating masses of nebula in some parts of the universe, in other parts old, extinct, frigid suns come into collision, and are once more reduced by the heat generated to the condition of nebulæ.

It appears, in fact, to be assumed that this cyclic process has been actually demonstrated, for we are told[1] that astronomy reveals, in the endless depths of space, " Millions of circling spheres, larger than our earth, and, like it, in an eternal rhythm of life and death."

Moreover, " life " is here to be understood literally, for it is a cardinal article of such evolutionary belief that equally with the foundation of cosmic bodies and the separation of planets, the production of organic life, of plants and animals, has been wrought by forces which the material universe contains within itself,[2] and accordingly,[3]

We now definitely know that the organic world on our earth has been continuously developed " in accordance with eternal iron laws." . . . An unbroken series of natural events, following an orderly course of evolution according to fixed laws, now leads the reflecting human spirit through long aeons from a primeval chaos to the present order of the cosmos.

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1 *Ibid.*, p. 2.

2 The 15th Chapter of Haeckel's *Natural History of Creation* is devoted to this point.

3 *Confession of Faith of a Man of Science*, p. 32.

Finally, at the back of all these processes, we are to recognize the one ultimate reality, the universe itself, which originates and undergoes all these evolutions. In its regard Professor Haeckel tells us [1] that,

> The universe, or cosmos, is eternal, infinite, and illimitable. Its substance, with its two attributes (matter and energy) fills infinite space and is in eternal motion. This motion runs on through infinite time as an unbroken development, with a periodic change from life to death, from evolution to devolution. . . .

And again: [2]

> The two fundamental forms of substances, ponderable matter and ether, are not dead and moved only by extrinsic force, but they are endowed also with sensation and will (though naturally of the lowest grade); they experience an inclination for condensation, a dislike of strain; they strive after the one and struggle against the other.

Moreover,

> Movement [3] is as innate and original a property of substances as is sensation.

Such is the raw material whose metamorphoses produce, or rather constitute, all possible worlds, while paramount over every thing dominates the "Law of Substance," under which title Professor Haeckel unites the scientific principles of the inde-

[1] *Riddle of the Universe*, p. 5. [2] *Ibid.*, p. 78.
[3] *Ibid.*, p. 86.

structibility of matter, and the conservation of energy. Thus is the conclusion reached,[1]

Towering above all the achievements and discoveries of the century we have the great comprehensive "law of substance," the fundamental law of the constancy of matter and force. The fact that substance is everywhere subject to eternal movement and transformation gives it the character also of the universal law of evolution. As this supreme law has been firmly established and all others are subordinate to it, we arrive at a conviction of the universal unity of nature and the eternal validity of its laws.

Accordingly we are to conclude with Goethe that all proceeds by iron law to the fulfilling of inevitable destiny; or as an ardent disciple proclaims, who undertakes to expound the new creed to the people, [2]

We rest in sure and certain hope that no force and no combination of forces can stop the process of Evolution, which from a speck of jelly has developed such living forms as Charles Darwin and Herbert Spencer, and which has produced the beauty of the earth and the heavens from formless ether.

This outline of the Evolutionary system in its widest and fullest sense will enable us to judge upon what grounds it can claim the sanction of Science. Various points here present themselves for consideration, which demand separate treatment.

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1 *Ibid*, 134.

2 *An Easy Outline of Evolution*, by Dennis Hird, M.A., Principal of Ruskin Hall, Oxford, p. 230.

V

WHAT IS A "LAW OF NATURE"?

As we have seen, the doctrine of Evolution is presented by its advocates as being based upon the existence of a "Law of Evolution," or "Law of Substance," which both brings about evolutionary processes, and certifies us of their occurrence, so that we may appeal to it as an authority for our belief in the facts of evolution themselves. Thus as Professor Milnes Marshall told the British Association,[1]

> The doctrine of descent, or of evolution, teaches us that as individual animals arise, not spontaneously, but by direct descent from pre-existing animals, so also is it with species, with families, and with larger groups of animals, and so also has it been for all time.

It is not said, be it observed, that the establishment of such facts teaches us the doctrine of evolution, but that the doctrine assures us of the facts; and the utterances constantly met with, of which the above is a fair sample, have no significa-

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[1] *Presidential Address, Section D, Zoology*, Leeds, 1890.

tion if they do not mean this. In the same way Professor Haeckel declares [1] that his fundamental cosmic law "establishes" the eternal persistence of matter and force, and their unvarying constancy throughout the entire universe, becoming thus "the pole-star that guides our Philosophy through the mighty labyrinth to a solution of the world problem," and the key to this supreme problem, he further tells us,[2] is found in one magic word—Evolution.

It would certainly appear from all this, that by "Evolution" we are to understand some sort of entity at the back of the world, with power at its disposal capable of effecting all its operations, —something in fact remarkably like the First Cause of which we are in search,—and that by its "Laws" are signified some definite forces, the practical action of which has been ascertained by us, so that we can foretell the course of events under them, as we can that of the planets or the tides under the influence of gravitation.

But is it scientific, or even intelligible, to use words thus, and to assign any such significance to such terms as "Law of Evolution," "Law of Substance," or any other "Law of Nature"? We are repeatedly warned to the contrary by so high an authority as Professor Huxley. Once, for instance, he discovered in a sermon of Canon Liddon's this "fallacious employment of the name

[1] *Riddle of the Universe*, p. 2.
[2] *Ibid.*, p. 83.

of a scientific conception," for which it was however added, the preacher "could find only too many scientific precedents."[1] This fallacious use of terms, which nowise differs from that under consideration, Professor Huxley thus denounces:

> It is the use of the word "law" as if it denoted a thing—as if a "law of nature," as science understands it, were a being endowed with certain powers, in virtue of which the phenomena expressed by that law are brought about. . . . All I wish to remark is that such a conception of the nature of "laws" has nothing to do with modern science. . . . A law of nature, in the scientific sense, is the product of a mental operation upon the facts of nature which come under our observation, and has no more existence outside the mind than colour has. The law of gravitation is a statement of the manner in which experience shows that bodies, which are free to move, do, in fact, move towards one another. . . . The tenacity of the wonderful fallacy that the laws of nature are agents, instead of being, as they really are, a mere record of experience, upon which we base our interpretations of that which does happen, and our anticipation of that which will happen, is an interesting psychological fact: and would be unintelligible if the tendency of the human mind towards realism were less strong.

A law, accordingly, "is not a cause but a fact,"[2] and we must learn laws from facts, not facts from

[1] "Pseudo-Scientific Realism," *Collected Essays*, i. 68, 74—78.

[2] Newman, *Grammar of Assent*. p. 72. A "Law of Nature," as has already been said, is simply a statement of what *de facto* has always been found to occur under certain conditions, and may consequently be expected again. It is obvious however that such expectation is implicitly based on the existence of some cause capable of ensuring the result.

laws. It is indeed evident on a moment's thought, that to speak of the Law of Evolution as causing things to be evolved, is like saying that the law of growth makes things grow. Till we know what happens, there is nothing of which Science can take account.

> True scientific teaching, I cannot too often repeat [says Professor Tait][1] requires that the facts, and their *necessary* consequences alone, should be stated, as simply as possible.

In like manner Professor Huxley,[2] undertaking to vindicate full scientific value for his own favourite Biology, does so by pointing out that biological methods are similar to those of every other branch of Science, since they begin with the observation of facts, and from this proceed to various applications of the knowledge so acquired. And Professor Haeckel himself tells us regarding his own mode of procedure:[3]

> The means and methods we have chosen for attaining the solution ot the great enigma do not differ, on the whole, from those of all purely scientific investigation: firstly, experience; secondly, inference.

Therefore, although the phrases we have already heard from him, are found when scrutinized to

[1] "The Teaching of Natural Philosophy," *Contemporary Review*, Jan., 1878.

[2] *Lay Sermons*, p. 83.

[3] *Riddle of the Universe*, p. 6.

be only phrases, which explain nothing, it may be supposed that he elsewhere produces such proofs of his doctrine as will place it on a scientific basis. For these we will now seek.

VI

"THE LAW OF SUBSTANCE"

WE have just been told by Professor Haeckel, that the means and methods which he has chosen for the establishment of his philosophy are, on the whole, identical with those employed in all purely scientific investigation, namely, first experience, and secondly inference.

But here a grave difficulty at once presents itself. How, either by experience or by inference, can we learn anything about the commencements of the universe, as to which we have heard so much? How the first bodies, whether organic or inorganic, actually arose, neither philosophy nor science can definitely say, for the latter was not there to see, and the former has no facts on which to argue.[1] But if neither by observation, nor by clear inference, can the account that has been given be substantiated, that account cannot pretend to be scientific, for it rests not upon knowledge but upon speculation,—and as Professor Tait warns us,[2]

[1] See Wasmann "Gedanken zur Entwicklungslehre," *Stimmen aus Maria-Laach*, vol. 63, p. 298.

[2] *Contemporary Review*, ut sup., p. 301.

"That of which there is no knowledge is not yet part of Science."

This plain consideration seems to account for a fact which is undoubtedly highly significant. Professor Huxley had certainly no prejudices against evolutionary systems, could they but be satisfactorily established. He knew all that Professor Haeckel has urged on behalf of his own theory, and showed how much he was in sympathy with it by naming after his friend the ill-starred *Bathybius Haeckelii*, the deep-sea slime which was at first supposed to bridge the gulf between the organic and the inorganic worlds, and to be living stuff in process of spontaneous manufacture. Nothing, in fact, as he himself admitted, in his controversy with Dr. Bastian, could have suited him better than a demonstration that Nature possesses all the powers necessary for her own processes, and that the explanation of all is within the scope of Science. But, at the same time, he reverenced scientific truth beyond anything else, and he was keenly sensible of the danger attending the use of hypothetical explanations, leading to conclusions which cannot be experimentally tested, which danger he carefully shunned.[1] Accordingly, not only did he never lend his countenance to what Professor Haeckel represents as the inevitable conclusions of Science, but he even plainly intimated that those who

[1] Professor Weldon, F.R.S., in the *Dictionary of National Biography.*

advanced such views were going much farther than Science warrants. The doctrine of Evolution, he declared,[1] is not only attacked on false grounds by its enemies, but is made by some of its friends to cover so much which is disputable, as to force him in self-defence to make his own position clear in its regard. And the first point of his explanation is to repudiate the idea that we have any such knowledge as Professor Haeckel assumes. "I have nothing to say," he writes, "to any 'Philosophy of Evolution.'"

Being thus necessarily destitute of support either directly from observation or by inference from observed facts, it would seem that only in one way can Professor Haeckel's system of cosmogony, or world-production, obtain any support from Science. If amongst the operations now in progress in the universe, is to be found evidence of an exhaustless and self-renewing energy, a mainspring capable of keeping the machine going everlastingly, then undoubtedly there will be an explanation forthcoming, which, whatever difficulties may still remain on other grounds, will at least furnish a complete mechanical account of things within the ken of Science. May we not suppose that this is what is claimed as being supplied by the "Law of Substance," which is represented as the cornerstone of the whole edifice, the supreme triumph of scientific discovery, and, in fine, "the universal

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[1] *Collected Essays*, v. 41.

law of evolution"? Let us see how far such a notion can be styled scientific.

As has been shown, a "Law" is nothing but a statement that a certain kind of fact is found to occur in certain circumstances. Professor Haeckel has told us that the "Law of Substance" is a blend of two such statements, namely, "the Law of the persistency or indestructibility of matter," which signifies that in no instance within our knowledge is any particle of matter destroyed, and "the Law of the persistence of force, or conservation of energy," which signifies that the sum of force, at work in the world, and producing all phenomena, is similarly found to be unalterable.[1]

It must here first be observed that the term "Conservation of Energy," is more correct and intelligible than "Conservation of Force"; by "Energy" being understood the power of doing "work," that is to say, of overcoming resistance.[2]

It is in this form alone that Force becomes subject to observation and can be measured by Science, and the Law of Conservation which observation

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[1] *Riddle of the Universe*, p. 75.

[2] Professor Garnett in the *Encyclopaedia Britannica*. By "Force" is understood "any cause which tends to alter a body's natural state of rest, or of uniform motion in a straight line." Of the nature of such causes science professes to know very little, and as Clerk-Maxwell, who knew as much as most men, sang apropos of a lecture of Professor Tait's:

> . . . Tait writes in lucid symbols clear
> one small equation;
> And Force becomes of Energy a mere
> space-variation.

reveals is thus stated: The sum of all the various energies in the universe is a constant quantity, which can be neither increased nor diminished, though it may be changed from one form to another;[1] such forms being motion, heat, chemical action, electricity, magnetism.

But another point is of far greater importance. The mode in which Professor Haeckel states this fundamental Law is altogether deceptive. He tells his readers only half the truth, and when the other half is told, not only is his whole doctrine found to receive no support from the Laws of Energy, but it is these very Laws which appear most incompatible with it.

For, along with the Law of the Conservation, there is another, of the Dissipation of Energy. It is perfectly true, as Professor Haeckel often repeats, that the sum of Energy existing in the universe remains ever the same: but it is no less certain, as he unfortunately fails to remind his readers, that the stock of Energy *available for the work of the universe* is growing less every day. Though none is ever destroyed, much is constantly *lost*, being dissipated, or radiated into space, in the form of heat which can never be recaptured or translated into any form which can be of any practical avail. "It is lost for ever as far as we are concerned."[2]

From what we have heard concerning the Law of

[1] Balfour Stewart, *Conservation of Energy*, § 115; by Clerk-Maxwell, *apud* Garnett, *ut sup.*

[2] Tyndall, *Fragments of Science*, 5th Edition, p. 23.

Substance it might naturally be supposed that it certified us of the continued existence of the power required to carry on the operations of Nature, and that, accordingly, reason bids us to suppose these operations to be everlasting. But this neglected element of the reckoning, or *Entropy* as it is styled, leads scientific men to an entirely different estimate. Thus Professor Balfour Stewart writes:[1]

> Although, therefore, in a strictly mechanical sense, there is a conservation of energy, yet, as regards usefulness or fitness for living beings, the energy of the universe is in process of deterioration. Universally diffused heat forms what we may call the great waste-heap of the universe, and this is growing larger year by year.
>
> We have [he continues] regarded the universe, not as a collection of matter, but rather as an energetic agent—in fact, as a lamp. Now it has been well pointed out by Thomson,[2] that looked at in this light, the universe is a system that had a beginning and must have an end; for a process of degradation cannot be eternal. If we could view the universe as a candle not lit, then it is perhaps conceivable to regard it as having been always in existence; but if we regard it rather as a candle that has been lit, we become absolutely certain that it cannot have been burning from eternity, and that a time will come when it will cease to burn. We are led to look to a beginning in which the particles of matter were in a diffuse chaotic state, but endowed with the power of gravitation, and we are led to look to an

[1] *Conservation of Energy*, § 209.

[2] Sir William Thomson, now Lord Kelvin.

end in which the whole universe will be one equally heated inert mass, from which everything like life or motion or beauty will have utterly gone away.

It is doubtless true that attempts have been made to show that this conclusion is not final, and that there may be resources whereby Nature is able to recoup herself, and to draw upon some bank unknown to us for her missing store. As we have seen, Professor Haeckel simply takes for granted that some such means of recuperation exist and operate, and he is not wholly without countenance from others. Thus, no less an authority than Sir William Crookes addressing the Chemical Society as its president, thus expressed himself:[1]

> If we may hazard any conjectures . . . we may I think premise that the heat radiations propagated outwards, . . . by some process of nature unknown to us, are transformed at the confines of the universe into the primary—the essential—motion of chemical atoms, which the instant they are formed, gravitate inwards, and thus restore to the universe the energy which would be lost to it through radiant heat. Hence Sir William Thomson's startling prediction falls to the ground.

But it need not be pointed out that if an advocate so eminent as Sir William Crookes is reduced to pleas like this on its behalf, the case for Renovation of Energy must be singularly destitute of anything resembling scientific support. Suppositions which

[1] March 29, 1888.

are avowedly hazarded as conjectures, and which must appeal to processes of Nature of which we know nothing, whatever authorship they may boast, have nothing to do with Science, and possess no sort of value for our purpose.[1] It must of course be allowed that we may still be utterly in the dark as to the whole of this question, and that further discoveries may one day completely upset all our present notions. But we are concerned with the evidence which Science has now before her, and with the assertion so confidently advanced that this makes the Law of ceaseless Evolution an indisputable truth. We find, on the contrary, that this Law runs directly counter to the facts as they are at present known to us, and to the conclusions drawn from them by the most authoritative representatives of science.

Nor is it only our own globe and solar system that appear to be thus bound towards an inevitable doom. The eternal rhythm of life and death, of which we have been told as pervading the endless depths

[1] So of another effort in the same direction Capt. Hutton tells us: "The last champion in the field is Professor A. W. Bickerton, who thinks he has found a way in which this dismal conclusion, as he considers it, may be averted. But he is not very sure about it, and has to assume: first, that space contains now and always will contain, a large quantity of cosmic dust scattered through it with some approach to uniformity; and secondly, that the Universe consists of an infinite number of what he calls 'cosmic systems,' travelling through space, constantly throwing off dust in all directions and occasionally colliding. As all this is pure assumption and highly improbable, I cannot think that Professor Bickerton has brought forward any serious objection to the theory of the dissipation of energy, and his hypothesis must be added to the list of failures." (*Lesson of Evolution*, p. 14, *n.*)

of space, has no better title to scientific sanction. Like the minor province which we inhabit, the whole universe, we are assured,—so far as we have means of calculating,—must ultimately arrive at a condition of eternal stagnation,—its component parts being drawn close together by their mutual attractions,—so that motion ceases; while the heat replacing it being equally diffused, becomes as incapable of doing work as water between two pools on the same level is of turning a mill. As the writer lately quoted sums up the matter:[1]

> Slow as the process of condensation is, it is not endless. In time all the meteoric dust will be collected into stars or planets; and in time the law of dissipation of energy will bring all these bodies to a uniform temperature. So at last the movements due to the original unequal distribution of matter will cease, and the life of the universe will come to an end. We know of no process of rejuvenescence, by means of which dissipation of energy and the force of gravitation might be counteracted. Several attempts have been made to refute the theory of the dissipation of energy, but all have failed.

This, however, is but the first of many difficulties which must be disposed of ere the account of the world's genesis which we are considering can pretend to our acceptance on the ground that reason and science proclaim its truth.

[1] *Lesson of Evolution*, p. 14.

VII

"THE SEVEN ENIGMAS"

THE doctrine that the universe is an automatic machine,—self-originated and self-sustained—undoubtedly rests upon a principle formally recognized by some evolutionists, as the "Law of Continuity," and taken for granted by many who do not put it into words. This principle is,—that everything must always have happened according to the same laws of Nature which operate now; that there can never have been a "miracle," understanding by this term whatever is beyond the scope of natural forces; and that, accordingly, the whole of the world's history,—one stage as much as another,—falls within the province of Science. By no one has this position been more clearly stated than by the late Professor Romanes.

All minds [he tells us] [1] with any instincts of science in their composition have grown to distrust, on merely antecedent grounds, any explanation which embodies a miraculous element. Such minds have grown to regard

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[1] *Darwin and after Darwin*, p. 17.

all these explanations as mere expressions of our own ignorance of natural causation ; or, in other words, they have come to regard it as an *à priori* truth that nature is always uniform in respect of method or causation ; that the reign of law is universal ; the principle of continuity ubiquitous.

He goes on to declare that " The fact of evolution —or, which is the same thing, the fact of continuity in natural causation—has now been undoubtedly proved in many departments of nature," and that, in particular, " throughout the range of inorganic nature " it is " a demonstrated fact."

If this be so, it must necessarily follow that the Laws of Nature, as Science finds them operating, sufficiently explain not only all that happens in our present world, but also all that must have happened while this world was being produced. According to what has already been said, by " The Law of Continuity " no more can be signified than that Continuity is a fact, that the world has actually come to be what it is through the continual operation of just the same natural forces as we find at work to-day. That things *did* so happen we have not and cannot have, direct evidence ; for no witness was there to report. We can but draw inferences from the present to the past, and argue that what Nature does to-day, she must have been capable of doing yesterday and the day before. Only thus can continuity of natural laws possibly be established. It would obviously be vain to

argue that we must suppose no other forces ever to have acted than those we can observe, because, for all we know, other conditions may so have altered as to make their results altogether different from any of which we have experience.

It is likewise manifest that if we are to speak of demonstrated facts, and of conclusions placed beyond rational possibility of doubt, proofs must be forthcoming sufficient to compel scientific assent.

And here lies the difficulty. Very much must unquestionably have happened in the course of the world's making for which the Laws of Nature as we find them now acting cannot account, and which, therefore, Science cannot attempt to explain. So we are assured by eminent scientific men,—men, too, who desire nothing more than to find an explanation, but are driven, in search of one, as we have already seen Sir W. Crookes, to plead the limitation of our knowledge, and that there may be capabilities in Nature of which we are ignorant. But it remains always true, that what we do not know is not yet part of Science, and that if our scientific information, so far as it goes, is adverse to the Law of Continuity, it is quite unscientific to bring arguments for the law not from our knowledge, but from our lack of it. Still more unscientific is it to proclaim that Science has pronounced judgment in a sense contrary to that of all the evidence hitherto presented to her.

Amongst the men of Science who testify as above, we may begin with Herr Du Bois-Reymond, an

avowed Evolutionist and Materialist, whom Professor Haeckel styles, "the all-powerful secretary and dictator of the Berlin Academy of Sciences."[1] He can be suspected of no prejudices which would prevent him from accepting Professor Haeckel's cosmogony, if only he found the evidence satisfactory. Far from this, however, he declares,[2] that the history of the universe confronts us with no less than seven problems, for which Science has no solution to offer, and some of which he holds to be for ever insoluble. These he styles "Enigmas," and they are:

(1) The nature of Matter and of Force.
(2) The origin of Motion.
(3) The origin of Life.
(4) The apparently designed order of Nature.
(5) The origin of sensation and consciousness.
(6) The origin of rational thought and speech.
(7) Free-will.

The first, second, and fifth of these are in the opinion of Du Bois-Reymond "transcendental," or beyond possibility of solution. The others, in his judgment, have certainly not yet been solved, but *perhaps* may be solved some day. As to the last, he much doubts whether it should not also be classed as "transcendental."

It thus appears that in the judgment of a competent witness, and one no-wise biassed by precon-

[1] *Riddle of the Universe*, p. 64.

[2] *Über die Grenzen der Naturerkennens: Die Sieben Welträthsel*, Leipzic, 1882.

ception or prejudice, so far from it being true that Professor Haeckel's story of the universe is imperiously imposed on us by the results of Science, not one but several great gulfs in the course of that history must have been bridged over somehow, which Science confesses she cannot bridge, so far as her present knowledge goes, that is to say, so far as she is Science at all.

Professor Haeckel, it is true, loudly pronounces Du Bois-Reymond's declaration to be mere "dogmatism"[1] of a "shallow and illogical character," and he undertakes to show that with the help of his own philosophy the enigmas cease to be enigmatical.

> In my opinion [he writes] the three transcendental problems (1, 2 and 5) are settled by our conception of substance; the three which he [Du Bois-Reymond] considers difficult, though soluble[2] (3, 4 and 6) are decisively answered by our modern theory of evolution; the seventh and last, the freedom of the will, is not an object for critical scientific inquiry at all, for it is a pure dogma, based on an illusion, and has no real existence.

How far such a mode of rebuking dogmatism appears convincing, must of course depend on what the reader understands by an argument. Some points already considered may help us to a right estimate of proofs which are based upon "Our

1 *Riddle of the Universe*, p. 64.

2 Du Bois-Reymond does not say that they are soluble, but only that he cannot pronounce them "transcendental."

conception of substance," or "Our modern theory of evolution," and we shall presently inspect more closely the nature of the difficulties which we are invited so summarily to dismiss. Meanwhile, even though not final or conclusive, the testimony of such a man as Du Bois-Reymond serves at least to prove that it is possible to be thoroughly familiar with Science and her teaching, and yet to believe that as yet she knows nothing at all concerning questions which, as we have been assured, she has conclusively answered. And, as we shall presently see, if Professor Haeckel's account of things be the true one, there are many more scientific men of the first rank who are equally in the dark.

In a word, while according to Professor Haeckel there is in the universe but one Riddle, which he tells us he has solved,—in the opinion of another who is certainly no less entitled to speak in the name of Science, there yet remain seven to which no answer has yet been given, and to three, at least, of which none will ever be found.

VIII

MATTER AND MOTION

In the forefront of the problems which have been pronounced to be not only unsolved but insoluble, are the nature and origin of the ultimate factors arrived at by Science in her study of the constitution of the universe,—Matter, Force, and Motion.

With the first and last of these alone need we at present concern ourselves, for "Force," as Science knows it, is always associated with Matter, and signifies no more in her terminology than that which produces, or tends to produce Motion. On the other hand, we are told,[1] that "The contents of the material universe may be expressed in terms of Matter and Motion."

By "Matter" is understood "Sensible Substance," the stuff composing all of which our senses tell us, and which forms the object of Scientific investigation. What do we know concerning this raw material whereof worlds are made?

As we have seen, Professor Haeckel and his school are ready to tell us. Matter, we are assured,[2] is self-

[1] Samuel Laing, *Modern Science and Modern Thought*, Cheap Edition, p. 19.

[2] *Riddle of the Universe*, p. 86.

existent and imperishable, "it has no beginning and no end; it is eternity." Together with Ether, it occupies infinite and boundless space. It is in ceaseless motion; and its interminable modifications produce everything that ever was or ever will be. Movement[1] is one of the "innate and original properties" of Matter. So are Sensation and Will,[2] but these, we are warned,[3] are "unconscious."

Obviously, however, it is not enough that these things should be said, they require likewise to be proved; and the question must immediately suggest itself, Whence is proof to come? Not, by any possibility, from observation and experiment. For who can speak, of his own knowledge, to eternity or infinity? The only conceivable supposition is that Science has so thoroughly mastered the nature and properties of Matter here and now, as to be furnished with evidence unmistakably pointing to the above conclusions. Thus alone can she be quoted on their behalf; and it must always be remembered that the philosophy which we are examining is nothing if not scientific.

But, in the first place, is it quite clear of what our philosophers are speaking? They use the term "Matter" as though it represented some one definite thing: but this is very far from being the case.

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[1] *Ibid.* [2] P. 78. [3] P. 64.

> We must remember [says Lord Grimthorpe][1] that matter is not an unit, as a creator is, and that talking of it so is merely a rhetorical artifice when used in philosophical inquiries. . . . Matter is nothing but the sum of all the ultimate particles or atoms contained in the universe, or in any particular mass that we are dealing with. . . . A very large proportion of the atoms of the universe have never been within millions and billions of miles of each other.

Therefore, he goes on to urge, the doctrine of the self-existence of Matter, must mean that each several atom is self-existent, or "every atom its own god." How comes it then that they all obey the same "Laws"? How have their various provinces been allotted? Above all, how are they not all the same, but—so far as we know—divided into classes widely different from one another? For, according to our present knowledge,—and we cannot too frequently remind ourselves that upon this alone can any sound conclusion be based,—there are, in round numbers, some seventy different species of atoms, whose diverse qualities are absolutely necessary for the production of the world. Had all atoms been of one kind, we could have had none even of what used to be called the Four Elements,—neither Earth, Air, Fire, nor Water.

But,—apart from this,—What is known concerning this same "Matter"? Has Science so thoroughly fathomed its constitution as to be able

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[1] *Origin of the Laws of Nature*, p. 23.

to declare that it possesses all the properties we have heard assigned to it,—Sensation and Will, even of the unconscious kind, whatever that may be,—locomotive power,—eternity,—and, in its collective capacity, immensity?

So far from this being the case, scientific men who were most willing, and even anxious, to assign to Matter a foremost, if not *the* foremost, place in Nature, have done so precisely upon the ground, not of our knowledge, but of our ignorance. No better examples need be sought than Professor Huxley, and Professor Tyndall, who alike agreed, in the words of the latter,[1] "to discern in Matter the promise and potency of every form and quality of life." But Huxley took his stand on the declaration, that we know so little about Matter as to make it impossible to say of what it may not be capable, for we cannot so much as be certain of its existence, and use the term only "for the unknown and hypothetical causes of our own states of consciousness,"[2] while Tyndall described the process, whereby the promise and potency are realized, as "the manifestation of a Power absolutely inscrutable to the intellect of man."

Speculations thus founded upon the absence of evidence, whatever else they may be, are certainly no part of Science; and when we turn to what, being established by scientific methods, is a possible basis of scientific argument, we find that in every instance

[1] *Belfast Address*, 1874.
[2] *Lay Sermons*. "On the Physical Basis of Life," p. 143.

it contradicts instead of supporting the assertions we have heard.

To begin with the question of Motion, as being both of supreme importance, and one more open than some others to observation and experiment. According to Professor Haeckel's teaching, "movement is an innate and original property of substance," that is to say of Matter, and in consequence, "Substance is everywhere and always in uninterrupted movement and transformation." It is by thus attributing to matter an inherent determination to move that he meets Du Bois-Reymond's difficulty as to the origin of motion.

But this is in direct opposition to the first of Newton's Laws, which are universally recognized as the most firmly established and unquestionable of all scientific conclusions. This law tells us that a body at rest will continue at rest for ever, unless compelled by some force to move; just as a body in motion will continue to move at the same rate and in the same direction, unless compelled by force to arrest or alter its course. Upon the universal certainty of this law the whole of our Natural Philosophy depends: but it absolutely blocks the way for the idea that Matter has an innate tendency to move itself, which is thus quite unscientific. Not self-movement but *Inertia* is the property which Science ascribes to Matter.[1] It may further be observed that the idea of inherent motion is absurd

[1] Professor Tait, *Properties of Matter*, § 108.

and unintelligible; for movement cannot be in more than one direction at a time: so that a mass, or an atom, of Matter could tend to move only by having an intrinsic impulse in a straight line towards some one particular point. If it should tend to move indifferently, in all directions at once, it would remain motionless, each such tendency being neutralized by its opposite.

As to the further claim made on behalf of Matter to be endowed with Sensation and Will, of any description, it must be enough to say that no one has ever pretended to find any evidence whatever to this effect, or to detect the faintest trace of such properties;—and that on the contrary, all experience shows inorganic Matter, (that is, Matter not incorporated in living animals or plants,) to be utterly lifeless and inert. It is a mere abuse and perversion of terms to speak of Science as countenancing any conclusion but that to which such experience points. The attempt to invest Matter with these attributes Professor Tait stigmatizes as "non-science," or "pseudo-science."[1]

The Pygmalions of modern days [he writes] do not require to beseech Aphrodité to animate the ivory for them. Like the savage with his *Totem*, they have themselves already attributed life to it. . . . The latest phase of this peculiar non-science tells us that all Matter is *alive;* or at least that it contains "the promise and potency" (whatever these may be) "of all terrestrial

[1] *Contemporary Review*, January, 1878, p. 301.

life." . . . So much for the attempts to introduce into Science an element altogether incompatible with the fundamental conditions of its existence.

In fine, to make us realize not merely how extremely narrow are the bounds of our knowledge, but even how much narrower they may be than we suppose, there enters upon the scene Radium, like the golden apple that came to disturb the harmony of the celestials. What lessons this turbulent and unconventional element will ultimately be found to teach, and how far it will revolutionize the laws of Nature as hitherto accepted, remains, of course, to be seen: but this at least is clear. In presence of it, scientific men find that they are sure of nothing they thought most certain, not of the indestructibility of matter itself, on which is based that Law of Substance which we have seen made responsible for so much.

It had been thought that whatever else might change or perish the atoms of which we have heard, as the ultimate constituents of Matter, were beyond the reach of any vicissitude. "No man," said Dalton, their discoverer, "can split an atom." Thus too Mr. Clodd, while acknowledging that the constitution even of atoms may some day be found to be liable to disorder and decay, clearly teaches that, as a practical certainty, we have in them got to something final. Taking one particular kind, an oxygen atom, as a text, he thus discourses: [1]

[1] *Story of Creation*, p. 11.

It matters not into how many myriad substances—animal, plant, or mineral—an atom of oxygen may have entered, nor what isolation it has undergone: bond or free, it retains its own qualities. It matters not how many millions of years have elapsed during these changes, age cannot wither or weaken it; amidst all the fierce play of the mighty agencies to which it has been subjected it remains unbroken and unworn; to it we may apply the ancient words, "the things which are not seen are eternal."

But now, with the recognition of radio-activity, and the disintegration of atoms into their constituent "electrons" which this is held to evidence, we have changed all that. Such disintegration, it is affirmed, must imply dissolution and death, alike of the atoms themselves and of the universe which they compose. As Sir William Crookes told the physicists assembled at Berlin, June, 1903:

This fatal quality of atomic dissociation appears to be universal, and operates whenever we brush a piece of glass with silk; it works in the sunshine and raindrops, in lightnings and flame; it prevails in the waterfall and the stormy sea.

Matter he consequently regards as doomed to destruction.[1] Sooner or later, it will have dissolved into the "formless mist" of "prothyle"[2] and "the hour-hand of eternity will have completed one revolution."

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[1] *Edinburgh Review*, October, 1903, p. 399.

[2] Or "primal stuff." This looks remarkably like the old *Materia Prima* of the Schoolmen translated into Greek.

Consequently, we are told,[1]

> The "dissipation of energy" has found its correlative in the "dissolution of matter." We are confronted with an appalling sense of desolation—of quasi-annihilation.

It is no doubt true, here again, that such judgments cannot be called final, and that not all scientific men will accept them as they stand. But all alike are forced to agree that our previous notions are completely upset, and that we are compelled to recognize the fact that of these fundamental questions we know far less than the little we seemed to know. What, then, is to be thought of Professor Haeckel's confident utterances, which could be justified only on the supposition that we know everything? And what becomes of the famous Law of Substance, if both its parts are found thus to contradict the conclusion he would draw from it?

The case is thus summed up by the writer of the article just cited:

> The discovery of radio-activity is one of the most momentous in the history of science. "There has been a vivid new start" (we again borrow Sir William Crookes' expression). "Our physicists have remodelled their views as to the constitution of matter." The remodelling indeed has hardly commenced. . . . What is undeniable is that the Daltonian atom has, within a

[1] *Ibid. The Revelations of Radium.*

century of its acceptance as a fundamental reality, suffered disruption. Its proper place in nature is not that formerly assigned to it, . . . its reputation for inviolability and indestructibility is gone for ever. Each of these supposed "ultimates" is now known to be the scene of indescribable activities, a complex piece of mechanism composed of thousands of parts, a star-cluster in miniature, subject to all kinds of dynamical vicissitudes, to perturbation, acceleration, internal friction, total or partial disruption. And to each is appointed a fixed term of existence. Sooner or later, the balance of equilibrium is tilted, disturbance eventuates in overthrow; the tiny exquisite system finally breaks up. Of atoms, as of men, it may be said with truth, "*Quisque suos patitur manes.*"

"Here," in fact, "we meet the impenetrable secret of creative agency."[1]

[1] *Ibid.*, p. 398.

[*Note.*—It is often assumed that the composite character of the atom—if fully established—must upset the Atomic Theory. This is not so; all that the new hypothesis does is to go further back in accounting for the Atomic Theory, and for all practical purposes things remain exactly as they were; except, indeed, that the dissolution of matter does away with what was held as one of the most assured conclusions of science.]

IX

THE PROBLEM OF LIFE

THE question concerning the origin and nature of Life is of supreme and vital importance not only for those who speak of Evolution as a force or principle by which everything is guided and governed, but also for such as understand by the term no more than a process which they say has actually occurred. Evolutionists of this second class disclaim, with Huxley, any "philosophy of Evolution." They are content to take the world as a going concern, at the farthest point in the past to which, even speculatively, Science can trace it, as that vast primordial nebula of which we have heard.[1] Given this,—assuming the existence of such a nebula, constituted as they suppose,—they believe that the whole subsequent history of the world is fully explained by the uniform action of the same laws of matter which we find in operation to-day. Not only is the establishment of our Solar System, of sun and planets, to be thus

[1] The Nebular Hypothesis itself is, of course, far from being an established certainty, and is not devoid of grave difficulties. Into these, however, it is not necessary now to enter.

accounted for, but likewise the production of life, of the organic world of plants and animals.

Hence it necessarily follows that life must originally have been evolved naturally from lifeless matter, for all are agreed that not only in the nebula, but on the earth when it first started its independent career, life did not, and could not, exist.

> There has been [says Virchow][1] a beginning of life, since geology points to epochs in the formation of the earth when life was impossible, and when no vestige of it is to be found.
>
> If the evolution hypothesis is true, [says Huxley][2] living matter must have arisen from not-living matter; for by the hypothesis the condition of the globe was at one time such that living matter could not have existed in it, life being entirely incompatible with the gaseous state.
>
> There was a time [says Tyndall][3] when the earth was a red-hot molten globe, on which no life could exist.

Accordingly, as Professor Huxley acknowledges, spontaneous generation is an evolutionary necessity. Unless such generation can be shown to have taken place, or at the very least unless it can be shown to be naturally possible, the theory which requires it cannot be an established truth. But it is precisely as a scientifically established truth

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[1] *Apud* Gaynor, *The New Materialism*, p. 83.

[2] *Encyclopaedia Britannica*, "Biology."

[3] *Apud* Gaynor, p. 84.

that the doctrine of Evolution is presented to us, so firmly established indeed that we are warned "to doubt it is to doubt science."[1] It presents itself, moreover, as the most precious result of modern research, the appearance of which is as a sunrise illuminating the field of knowledge.[2]

This being so, and it being the first principle of Science that we should take nothing on faith and accept only what can be proved, it is our plain duty to satisfy ourselves, as scientific methods alone can rightly satisfy us, that a doctrine of such paramount importance is entitled to demand our acceptance.

What methods can claim to be scientific, all are agreed. Advances in science, Professor Tait warns us,[3]

> come or not, as we remember or forget that our Science is to be based entirely upon experiment, or mathematical deduction from experiment.

> Men of science [says Tyndall] prolong the method of nature from the present into the past. The observed uniformity of nature is their only guide.[4]

> The man of science [says Huxley] has learned to believe in justification, not by faith, but by verification.[5]

In this manner must we test the Evolution theory, and spontaneous generation as an essential element

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[1] Professor Marsh.

[2] Professor Dewar at Belfast, 1902.

[3] *Recent Advances in Physical Science*, 3rd Edition, p. 6.

[4] Gaynor, p. 102.

[5] *Lay Sermons*, p. 18.

thereof. We will begin with Professor Huxley's statement of what he styles "the fundamental proposition of Evolution."[1]

That proposition is [he writes] that the whole world, living and not-living, is the result of the mutual interaction, according to definite laws, of the forces possessed by the molecules of which the primitive nebulosity of the universe was composed. If this be true, it is no less certain that the existing world lay, potentially, in the cosmic vapour ; and that a sufficient intelligence could, from a knowledge of that vapour, have predicted, say the state of the Fauna of Britain in 1869[2] with as much certainty as one can say what will happen to the breath in a cold winter's day.

That is to say, the supposed nebula was a vast piece of mechanism, of unimaginable complexity, the component parts of which under the influence of such forces as gravitation, heat, chemical affinity, electricity and magnetism, have produced everything that has since appeared on earth, vegetable and animal life amongst the rest. How are we to assure ourselves that such was really the case ?

Professor Tyndall has told us that the only scientific method is to prolong the method of nature from the present into the past, taking her observed uniformity for our only guide, and in like manner we have heard it laid down by Professor Romanes, that we must assume as a first principle

[1] *Critiques and Addresses*, p. 305.

[2] Being the year in which this passage was written.

that the laws of nature are always and everywhere the same, and that by their uniform operation everything is done. It is therefore quite clear that as no man was present when life first made its appearance, to observe and record whence it came, the only way in which we can possibly proceed, without violating every scientific canon, is to argue from what happens now, to what must have happened then,—to show that inorganic matter can in fact generate organic life, and to conclude that the same laws must have worked the same results in the past as they do in the present.

But this is precisely what cannot be done, for one of the most conclusive results of modern research has been to show that in the present world spontaneous generation never occurs, that living things come only from living parents, and that from organic matter alone can the smallest particle of organic matter be derived. *Omne vivum e vivo, omnis cellula e cellula, omnis nucleus e nucleo.* Upon this point there is now complete agreement amongst scientific authorities, and what is most remarkable, none are more strenuous in upholding the doctrine of *Biogenesis*,[1] than some of those who with equal vehemence proclaim the doctrine of Evolution for which the occurrence of spontaneous generation is a necessity.

Never, for example, were there Evolutionists

1 Viz. that of the derivation of life from life alone, as opposed to *Abiogenesis*, or its production from lifeless matter.

more pronounced than Professors Huxley and Tyndall, and they both saw clearly that without spontaneous generation there could not have been evolution such as they maintained. Yet when the occurrence of spontaneous generation, here and now, was asserted by Bastian and Burdon Sanderson, they, following in the wake of Pasteur, repudiated the notion, and Tyndall in particular conclusively disproved the experiments by which it was supported.[1] As Huxley wrote to Charles Kingsley:[2]

> I am glad you appreciate the rich absurdities of spontogenesis. Against the doctrine of spontaneous generation in the abstract I have nothing to say. Indeed it is a necessary corollary from Darwin's views if legitimately carried out.

A few years later, writing to Dr. Dohrn[3] upon the same subject, he made use of a phrase—which in his mouth expressed the uttermost limit of disbelief: "Transubstantiation will be nothing to this if it turns out true."

In the same year as President of the British Association he chose for the subject of his inaugural address, "Biogenesis and Abiogenesis," and, after a careful examination of the case for each, pronounced the former "to be victorious all along the line."

In spite of all this, however, he assured himself

[1] See *Fragments of Science*, "Spontaneous Generation," for a full account.

[2] March 18, 1863. *Life and Letters*, i. 352.

[3] April 30, 1870. *Ibid.* ii. 17.

as an Evolutionist that spontaneous generation must once have been not only a possibility but a fact. In the same Presidential address, after piling up evidence against it—he thus continued:[1]

But though I cannot express this conviction of mine too strongly, I must carefully guard myself against the supposition that I intend to suggest that no such thing as Abiogenesis has ever taken place in the past, or ever will take place in the future. With organic chemistry, molecular physics and physiology yet in their infancy, and every day making prodigious strides, I think it would be the height of presumption for any man to say that the conditions under which matter assumes the properties we call "vital" may not, some day, be artificially brought together. All I feel justified in affirming is that I see no reason for affirming that the feat has been performed yet.

And looking back through the prodigious vista of the past, I find no record of the commencement of life, and therefore I am devoid of any means of forming a definite conclusion as to the conditions of its appearance. Belief, in the scientific sense of the word, is a serious matter, and needs strong foundations. To say, therefore, in the admitted absence of evidence, that I have any belief as to the mode in which the existing forms of life have originated, would be using words in a wrong sense. But expectation is permissible where belief is not; and if it were given me to look beyond the abyss of geologically recorded time to the still more remote period when the earth was passing through physical and dynamical

[1] *Critiques and Addresses*, p. 238.

conditions, which it can no more see again than a man can recall his infancy, I should expect to be a witness of the evolution of living protoplasm from not living matter. . . . That is the expectation to which analogical reasoning leads me; but I beg you once more to recollect that I have no right to call my opinion anything but an act of philosophical faith.

Here we have the whole state of the case put for us in a nutshell. On the one hand, all known facts are against the idea of spontaneous generation, and therefore, so far as she can at present go, the verdict of Science must condemn that supposition. But, on the other hand, the fundamental principle of Evolution cannot be justified unless spontaneous generation has taken place, and accordingly, although Evolution is the very thing which we should be engaged in establishing by the evidence of facts, it is held to be reasonable and scientific to infer that facts which we cannot verify must exist because they are wanted. It is admitted that the requisite evidence is lacking, and therefore we must not go so far as to express belief in the facts: but we may indulge in expectations,—which seem, however, to imply belief in the thing expected,—and meanwhile we may go on believing firmly in the Evolution theory itself, which includes belief in the missing facts. This, we are told, is "philosophical faith." But, to say nothing of what we have heard from others, Professor Huxley elsewhere[1] warns us against

[1] *Lay Sermons*, p. 18.

faith as the one unpardonable sin: and as we have heard him declare the man of science has learned to believe in justification, not by faith, but by verification.

And as to the expectation which he avowed, there appears to be no slight force in the response of his adversary Dr. Bastian:[1]

> What reason [he asks] does Professor Huxley give in explanation of his supposition? . . . The only reason distinctly implied is because the physical and chemical conditions of the earth's surface were different in the past from what they are now. And yet, concerning the exact nature of their differences, or the degree in which the different sets of conditions would respectively favour the occurrence or arrest of an evolution of living matter, Professor Huxley cannot possess even the vaguest knowledge. He chooses to assume that the unknown conditions existing in the past were more favourable to *Archebiosis* (life-evolution) than those now in operation. This, however, is an assumption which may be entirely opposed to the facts.

It is thus hard to understand how Professor Huxley could profess to justify his expectations by verification, for that the above account of the matter is no-wise overstated we have his own acknowledgment:[2]

> Of the causes which have led to the origination of

[1] *Evolution and the Origin of Life*, 1874, p. 23.
[2] *Encyclopaedia Britannica*, "Biology."

living matter, it may be said that we know absolutely nothing. . . . Science has no means to form an opinion on the commencement of life; we can only make conjectures without any scientific value.

Such a witness as Huxley might well suffice, but the question is so important as to make it advisable to call some others, though only a few amongst many who testify to the same effect.

Like his friend and ally Huxley, Professor Tyndall believed that spontaneous generation had once occurred, and denied that it occurs now. As to the former article of his creed he was even more pronounced in his materialism. We have already heard him proclaim that in matter is to be discerned the promise and potency of all terrestrial life. He likewise inclined to believe that not only life but consciousness is immanent everywhere, in the vegetable and mineral no less than in the animal world,[1] and that not merely life and consciousness, but:

All our philosophy, all our poetry, all our science, and all our art—Plato, Shakespeare, Newton, and Raphael—are potential in the fires of the sun.[2]

Beliefs such as these might be thought to imply that the genesis of life is a simple affair, but Tyndall was no less convinced than Huxley that, as things are, it cannot be obtained without antecedent life

[1] *Fragments of Science.* "Rev. James Martineau and Belfast Address."
[2] *Ibid.* "Scientific use of the imagination."

on which to draw. Having described the experiments devised to test the matter, he thus concludes: [1]

> Here, as in all other cases, the evidence in favour of spontaneous generation crumbles in the grasp of the competent enquirer.

At the same time, he was equally certain that life must have had an inorganic origin and that Science bids us so to believe. His various utterances are not, it is true, very easily reconciled. On the one hand he lays it down that "Without verification a theoretic conception is a mere figment of the intellect." On the other hand in his Belfast Address he thus expressed himself:

> Believing, as I do, in the continuity of nature, I cannot stop abruptly where our microscopes cease to be of use. Here the vision of the mind authoritatively supplements the vision of the eye. By a necessity engendered and justified by Science I cross the boundary of the experimental evidence. . . . If you ask me whether there exists the least evidence to prove that any form of life can be developed out of matter, without demonstrable antecedent life. . . . [men of science] will frankly admit their inability to point to any satisfactory experimental proof that life can be developed, save from demonstrable antecedent life.

Far, however, from being a mere figment, his

[1] *Fragments of Science,* "Spontaneous Generation."

mental vision is represented as the most unalloyed product of reason. He writes: [1]

> Were not man's origin implicated, we should accept without a murmur the derivation of animal and vegetable life from what we call inorganic nature. The conclusion of pure intellect points this way and no other.

The conclusion of pure intellect, however, having nothing to show for itself in the way of evidence, we are again referred to a condition of things concerning which we know, and can know, nothing.

> Supposing [writes the Professor] [2] a planet carved from the sun, set spinning round an axis, and revolving round the sun at a distance from him equal to that of our earth, would one of the consequences of its refrigeration be the development of organic forms? I lean to the affirmative.

It is no doubt interesting to know to what opinion the Professor inclined, but is this sort of thing Science?

In the same manner Mr. Herbert Spencer, the philosopher of evolution *par excellence*, thus reports: [3]

> Biologists in general agree that in the present state of the world no such thing happens as the rise of a living creature out of non-living matter. They do not

[1] *Ibid.* "Rev. James Martineau and Belfast Address."

[2] *Ibid.* "Vitality."

[3] *Nineteenth Century*, May, 1886, p. 769.

deny, however, that at a remote period in the past, when the temperature of the surface of the earth was much higher than at present, and other physical conditions were *unlike those we know*,[1] inorganic matter, through successive complications, gave origin to organic matter.[2]

Mr. Darwin himself, who is constantly supposed to have upheld, or even to have demonstrated, the fact of spontaneous generation, is amongst the strongest witnesses against it. He was indeed disposed to believe that the living will some day be found to be producible from the lifeless, the ground of his expectation being the "Law of Continuity,"[3] or the assumption that from the beginning of nature to the end one only kind of law uniformly operates, namely the same as we now experience. But this is to assume the whole

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[1] Italics mine.

[2] It has been established by Pasteur and others that the highest temperature at which organic life is possible is 45° *Centigrade* (113° *Fahrenheit*) When the globe had cooled to this point from its primitive molten condition, the epoch of terrestrial life commenced.

According to what is perhaps the latest theory, that of M. Quinton, the temperature immediately below this, 44° *Centigrade*, remains always the best for living things, and those creatures are highest in the scale of life, and consequently the most developed, which have contrived means of keeping their internal heat at, or about, this level, despite the refrigeration of their surroundings. In their blood-heat M. Quinton therefore finds an absolute rule for fixing the relative rank of organic forms, and the date of their appearance; those whose blood is warmest being the most recently evolved. The results of this new system are sufficiently startling. Birds are to be classed as the highest and newest of all; while man, with the other *Primates*, has to take a much lower place, the ungulates, including the horse and donkey, and the carnivora, as dogs and cats, being his superiors. (*La Revue des Idées*, January 15, 1904, pp. 29 seq.)

[3] To D. Mackintosh, February 28, 1882.

question at issue, for unless it can be shewn that there has been spontaneous generation, we cannot be assured that there is such a Law of Continuity. And despite his expectation Darwin always denied that the origin of life has been—sometimes even that it can be—explained. Thus he wrote on various occasions:

It is mere rubbish thinking at present of the origin of life; one might as well think of the origin of matter.[1]

As for myself I cannot believe in spontaneous generation, and though I expect that at some future time the principle of life will be rendered intelligible, at present it seems to me beyond the confines of Science.[2]

No evidence worth anything has as yet, in my opinion, been advanced in favour of a living being, being developed from inorganic matter.[3]

Here we may conveniently pause and take stock of our results. On the one hand, we are bidden in the name of Science to learn the past from the present, and the present from observation and experiment alone. On the other, we are invited to believe in an occurrence which observation and experiment negative in the present, on the ground that the circumstances must once have been entirely different from any with which we are acquainted. Obviously, the real motive of belief is that naïvely expressed by Professor Haeckel, who tells us that spontaneous generation is proved by the doctrine

[1] To Sir J. D. Hooker, March 29, 1863.
[2] To V. Carus, November 21, 1866.
[3] To D. Mackintosh, February 28. 1882.

of Evolution;[1] which then in its turn is proved by spontaneous generation.

Two points must however be noticed in which it is attempted to find present evidence in favour of spontaneous generation.

First, there is Protoplasm—the "Physical Basis of Life," or Living Matter, being that form of matter by which life is always accompanied. In this no chemical element unknown elsewhere, is to be found; the cells of which it consists are compounded of Oxygen, Hydrogen, Nitrogen, and Carbon; and it has been argued, especially by Huxley, that it is therefore not different in kind from other compounds; that as Oxygen and Hydrogen form water, Oxygen and Carbon, Carbonic Acid, Hydrogen and Nitrogen, Ammonia,—so the four combined, in proper circumstances and proportions, make Living Matter, without the aid of any vital force or principle. And Haeckel with his habitual audacity foretells the artificial production of Protoplasm for purposes of commerce. But, as Mr. Stirling observes,[2] man has always known that he is made of dust, and that the only part of him perceptible to sense is substantially the same as the earth beneath his feet. All that he now learns in addition is that when such matter is wedded to life it undergoes marvellous transformations which in part at least we are able to recognize, but are wholly unable to comprehend. This Professor Huxley himself admits:

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[1] *Riddle of the Universe*, p. 6.

[2] *As regards Protoplasm*, p. 21.

> The properties of living matter [he writes][1] distinguish it absolutely from all other kinds of things, and the present state of knowledge furnishes us with no link between the living and the not-living.

Not only that: the subject is full of complexities of which Professor Huxley gives no hint, and which it would even seem he did not himself perceive. In his celebrated lecture on the Physical Basis of Life [2] he gives his hearers to understand that all Protoplasm is the same, that its particles are as the bricks with which any sort of edifice may be constructed, a cathedral or a gin-shop, a palace or a hovel. The protoplasm of a mushroom, for instance, he declares to be essentially identical with that of him who eats it, into which it is most readily convertible. He also speaks of the effect of eating mutton being to "transubstantiate sheep into man." But, positive as are these statements, they are far from representing scientific truths, and we are told by Sir William Thiselton-Dyer that he himself would not know what to do with a candidate who should advance such views in an examination.[3] As to the mushroom and the mutton, Sir William adds, that except the definition of a crab, as a red fish that runs backwards, attributed to the French Academy, he can call to mind no statement "so compact of error."

[1] *Encyclopaedia Britannica*, "Biology."

[2] Printed in *Lay Sermons*.

[3] *Nature*, June 5, 1902, p. 121.

In reality, instead of all Protoplasm being the same, the differences are infinite. Particles from different sources may be indistinguishable by the microscope or by any test that chemistry can apply, but this only increases the mystery of their nature, for each has its own functions and will perform no others. The Protoplasm of a plant will do what that of an animal, seemingly identical, cannot do. That of a fish will convert the same nutriment into quite a different formation from that of a man.

It is no doubt true that a particle of fungoid differs in no appreciable physical respect from one of human protoplasm, yet the former will never emerge from the fate of the humble mushroom, while the other may be instinct with the thoughts of a Prime Minister.[1]

As Mr. Stirling sums up the matter:[2]

There is nerve-protoplasm, brain-protoplasm, bone-protoplasm, muscle-protoplasm, and protoplasm of all the other tissues, no one of which but produces only its own kind, and is uninterchangeable with the rest. Lastly, we have the overwhelming fact that there is the infinitely different protoplasm of the various infinitely different plants and animals, in each of which its own protoplasm, as in the case of the various tissues, but produces its own kind, and is uninterchangeable with that of the rest.

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1 *Id. ibid.*

2 *Op. cit.* p. 27.

It thus appears that the character of Protoplasm, far from making it easier to conceive the mechanical production of living things, does but immensely aggravate the difficulty. As Sir William Thiselton-Dyer avows: "I do not see even the beginning of a materialistic theory of protoplasm." And Haeckel's idea that we shall succeed in creating organic life does not commend itself to such an authority as Sir Henry Roscoe:

It is true [he says] [1] that there are those who profess to foresee that the day will arise when the chemist, by a succession of constructive efforts may pass beyond albumen, and gather the elements of lifeless matter into a living structure. Whatever may be said of this from other standpoints, the chemist can only say that at present no such problem lies within his province. Protoplasm, with which the simplest manifestations of life are associated, is not a compound, but a structure built up of compounds. The chemist may successfully synthesize any of its component compounds, but he has no more reason to look forward to the synthetic production of the structure than to imagine that the synthesis of gallic acid leads to the artificial production of gall-nuts.

And M. de Quatrefages thus sums up the conclusions at which he arrives from minute study of the lowest forms of life: [2]

[1] *Presidential Address*, British Association, 1887.

[2] *Les Emules de Darwin*, ii. 66.

I make bold to affirm that the deeper Science penetrates into the secrets of organization and phenomena, the more does she demonstrate how wide and how profound is the abyss which separates brute matter from living things.

The other point requiring notice is crystallization. Inorganic matter, as we know, can build up crystals, the wonderful structure of which results from the molecular properties of the substance crystallized. Why then, some would ask, may not matter in the same manner produce Protoplasm ?

But, in the first place, this, as we have heard, is what it is never found to do. Crystals we can produce at pleasure, in what quantity we will. But all efforts have not yet succeeded in obtaining the most minute speck of living matter. Moreover, nothing can be more widely different from organic structures than crystals. The latter are always mathematical, the former never : the latter grow by outside accretion, of the one kind of particles whereof they consist : the former by absorption and assimilation of various foreign substances : the latter are wholly independent of anything like an ancestor : for the former an ancestor is in our experience indispensable : crystals can be dissolved and re-crystallized : living matter once destroyed can never be reconstituted. Above all, the particles incorporated in the crystal are absolutely quiescent, so far as any portion of matter can be said to be so, no more able to change their position without external force than the bricks in a wall, while those

in living tissue at once become subject to "the whirlwind of life," involving constant change the cessation of which is death.

It is inexplicable to me [says M. de Quatrefages][1] that some men whose merits I otherwise acknowledge, should have compared crystals to the simplest living forms. . . . These forms are the antipodes of the crystal from every point of view.

To the same effect speaks Mr. A. R. Wallace, Mr. Darwin's associate in the discovery of the Darwinian theory. In a work expressly devoted to the vindication of that theory, Mr. Wallace declares that far from the way of evolution being made clear by Science from end to end—"there are at least three stages in the development of the organic world where some new cause or power must necessarily have come into action." And at the head of them he places that which we are now considering, writing thus:[2]

The first stage is the change from inorganic to organic, when the earliest vegetable cell, or the living protoplasm out of which it arose, first appeared. . . . There is in this something quite beyond and apart from chemical changes however complex; and it has been well said that the first vegetable cell was a new thing in the world, possessing altogether new powers. . . .[3]

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1 *Op. cit.* ii. 63.

2 *Darwinism*, p. 474.

3 The other stages presenting similar difficulties are the 5th and 6th of Du Bois-Reymond's Enigmas, viz. the introduction of sensation or consciousness (animal life), and of rational thought and speech.

Such testimonies are sufficient for our present purpose. In face of them it cannot be pretended that Science *knows* anything of spontaneous generation or gives her verdict in its favour. On the contrary, as Professor Tait declares :[1]

> To say that even the very lowest form of life, not to speak of its higher forms, still less of volition and consciousness, can be fully *explained* on physical principles alone, . . . is simply unscientific. There is absolutely nothing known in physical science which can lend the slightest support to such an idea. . . . To suppose that life, even in its lowest form, is wholly material, involves either a denial of the truth of Newton's laws of motion, or an erroneous use of the term "Matter." Both are alike unscientific.

Yet it is precisely in the name of Science that we have been told to accept the spontaneous origin of life from inorganic matter, as a clearly demonstrated truth, and no riddle at all.

But as Professor Virchow, Evolutionist and Materialist as he was, well said in regard of this very point in the Munich Congress of 1877 :

> If we would speak frankly, we must admit that naturalists may well have some little sympathy for the *generatio aequivoca* [spontaneous generation]. If it were capable of proof, it would indeed be beautiful! But, we must acknowledge, it has not yet been proved. The proofs of it are still wanting. . . . Whoever recalls

[1] *Contemporary Review*, January, 1878, p. 298.

to mind the lamentable failure of all the attempts to discover a decided support for the *generatio aequivoca* in the lower forms of transition from the inorganic to the organic world, will feel it doubly serious to demand that this theory, so utterly discredited, should be in any way accepted as the basis of all our views of life.

X

ANIMAL AND MAN

Leaving for later consideration the fourth of Du Bois-Reymond's Unsolved Enigmas, namely the seemingly pre-ordained order of the universe, we may conveniently group together the three which follow it, as much resembling that which has just occupied our attention. These problems, it will be remembered, are (*a*) the origin of simple sensation and consciousness, or, in other words, of the faculties possessed by animals; (*b*) that of rational thought and speech; (*c*) Free-will.—Here again we are bound to ask, in the name of right reason and common-sense, what light has really been thrown on such questions by Science, and how far she has changed their aspect,—that so we may guard against the delusion of imagining ourselves to be in possession of more knowledge than we actually possess.

(*a*) *Simple sensation and consciousness*. As regards the actual origin of the higher form of life which distinguishes the animal from the vegetable, we are obviously no better informed than we have found ourselves to be concerning the first beginnings of life in any form,—no evidence as to the actual facts being

available, or even possible, for our enlightenment. Once more we can only argue from the present to the past, and enquire whether the progress of science has made it more reasonable to suppose than it seemed in pre-scientific days that animal life has been spontaneously evolved, either from inanimate matter or from the vegetative life of plants. This enquiry so much resembles that which we have just concluded as to make it unnecessary to pursue it at any length.

We find, in fact, that men of Science who have no prepossessions whatever against Evolution, and would willingly accept the Law of Continuity at all points, if only evidence were forthcoming, find here not only an unsolved problem, but one even more difficult than the Origin of Life itself. Du Bois-Reymond for example places this amongst his "transcendental" enigmas, to which an answer will never be found, whereas he thinks that the origin of vegetable life, although at present a mystery, may one day be explained. The expression of his opinion,—that by no possibility can we ever understand how consciousness could be evolved from matter—has, he tells us[1] been vehemently contradicted, but, he adds, nothing in the way of argument, or beyond mere assumptions, has been brought against him. Of these assumptions he notices only that of Professor Haeckel, "the Prophet of Jena," who protests against such limitations of our possibilities as treason to the sacred cause of Evolution.

[1] *Die sieben Welträthsel*, p. 82.

The progress we have made in intellect, says Haeckel, beyond our barbarous progenitors, is sufficient to show that we are on the high road of development towards a stage as far in advance of the present, as this is of the past; and when that is attained, our knowledge will be full and will embrace all this. But, asks Du Bois-Reymond in reply, is this mighty progress of ours so very evident within the period concerning which we have any information? Has the mental capacity of our race notably improved since Homer?[1] or its faculty of thinking since Plato and Aristotle? At our present rate of progress, long before the high-water mark prophesied by Haeckel is reached, the earth will have become uninhabitable. And, were it otherwise, the highest point of intellect to which conceivably man could attain, would be that of the "sufficient intelligence" whereof we have been told, which, from an inspection of the cosmic nebula could foretell all that was to issue from it. And, adds Du Bois-Reymond, even could we do this, we should still be unable to understand the origin of consciousness, which would require intelligence of another order than ours, however magnified.

So again Mr. Wallace tells us,[2] after speaking of the beginning of life as we have already heard,

[1] Professor Huxley, it must be remarked, speaks of Homer as a "half savage Greek" (*Lay Sermons*, p. 12), and intimates a mild wonder that such a being could share our feelings in presence of nature to so large an extent as his poems testify. This is undoubtedly a fine example of the good conceit of ourselves which the pursuit of science is rather apt to produce.

[2] *Darwinism*, p. 475.

The next stage is still more marvellous, still more completely beyond all possibility of explanation by matter, its laws and forces. It is the introduction of sensation or consciousness, constituting the fundamental distinction between the animal and vegetable kingdoms. Here all idea of mere complication of structure producing the result is out of the question. We feel it to be altogether preposterous to assume that at a certain stage of complexity of atomic constitution, and as a necessary result of that complexity alone, an *ego* should start into existence, a thing that *feels*, that is conscious of its own existence. Here we have the certainty that something new has arisen, a being whose nascent consciousness has gone on increasing in power and definiteness till it has culminated in the higher animals. No verbal explanation or attempt at explanation—such as the statement that life is the result of the molecular forces of the protoplasm, or that the whole existing organic universe from the amœba up to man was latent in the fire-mist from which the solar system was developed—can afford any mental satisfaction, or help us in any way to a solution of the mystery.

Unquestionably, there is no lack of speakers and writers who flatly contradict such views, and assert that animal life, equally with vegetable, could be, and must have been, naturally evolved from inorganic nature. The above testimonies, however, amply suffice for our present purpose, and with them we may be satisfied; for at least they make it plain that Science has found no evidence as to the origin of sensation and con-

sciousness conclusive enough to compel belief. And where there is no scientific evidence even alleged, such as might require the training of a specialist for its due appreciation, one man of ordinary intelligence is as competent a judge as another, and scientific experts are on a level with the rest of us.

(*b*) *Rational thought and speech.* What has just been said applies with equal force to this matter likewise. Unless Science have some positive evidence to bring, demonstrating how the gulf can be bridged which separates the intelligence of the most degraded races of men from the highest of the brutes, and how articulate language can spontaneously have arisen, which is the necessary appanage of reason, we have all equally the means of forming our conclusions on the subject.

That the gulf between man and the lower animals is here immense we have the evidence of Mr. Darwin.

> No doubt [he writes] [1] the difference is in this respect enormous, even if we compare the mind of one of the lowest savages, who has no words to express any number higher than four, and who uses no abstract terms for the commonest objects or affections, with that of the most highly organized ape. The difference would, no doubt, still remain immense, even if one of the highest apes had been improved and civilized as much as a dog has been in comparison with its parent form, the wolf

[1] *Descent of Man*, c. ii.

or jackal. The Fuegians rank amongst the lowest barbarians; but I was continually struck with surprise how closely the three natives on board H.M.S. *Beagle*, who had lived some years in England and could talk a little English, resembled us in disposition and in most of our mental faculties.

Mr. Darwin goes on to argue, however, that the difference between man and beast is one of degree only and not of kind; that this can be "clearly shewn"; and that there is unquestionably

a much wider interval in mental power between one of the lowest fishes, as a lamprey or lancelet, and one of the higher apes, than between an ape and a man; yet this immense interval is filled up by numberless gradations,

from which he concludes that by a like series of steps, of which, however, no trace is left, our progenitors have been able to mount from the simian to the human level.

Clear however as Mr. Darwin pronounces the evidence to be, it is very far from being so considered by other eminent naturalists. So convinced an Evolutionist as Mr. Mivart, for example, declared on various occasions that his reason abundantly sufficed to convince him that there was a wider break in nature between man and the highest ape, than between the highest ape and an oyster or even a mushroom.

It is evident that the evidence which permits judgments so diverse as these cannot be said conclusively

to prove the former existence of a bridge every vestige of which has, by the acknowledgment of all parties, entirely disappeared. We are therefore left to determine for ourselves, whether the powers of our own mind, as each knows them in himself, are of a totally different nature from those of dogs and horses, and chimpanzees such as the late lamented "Consul," or whether we are superior only in degree, as a sheep-dog is more intelligent than a sheep, or a fox than a goose.

If in any respect such an enquiry can be made definite and therefore profitable, it is clearly in regard of Language. This, as said above, is an essential adjunct of reason such as ours, and on the other hand it forms the plainest boundary between the domain of the human race and that of the brutes. It is, says Professor Max Müller, our Rubicon on the hither side of which men alone are found. Given reason such as ours, whatever mode of communication might be open to them, we cannot suppose its possessors failing to establish a medium of intercourse. In existing conditions, man can make an alphabet out of the clicks of a needle or the flashes of a mirror, and if his vocal organs were no better than those of a baboon, we cannot imagine him content generation after generation with inarticulate howls and yells. But this is just the case of the animals. They are *never* found to make the smallest progress in the direction of a code of signals. Dogs indeed, as Mr. Darwin says,[1] having

[1] *Ibid.* 54.

developed in captivity the new art of barking, have further learnt to vary this accomplishment according to the circumstances that provoke it, and have distinct tones to express the diversity of their feelings, as when hunting, or angry, or setting out for a walk, or shut up in a kennel or out of a house. Some dogs, he might have added, refine still further, and will betray by their style of bark not only that they are hunting something, but what it is that they have come upon, whether a rabbit, a cat, or a hedgehog. But, as the Chevalier Bunsen observes,[1] and his observation includes such manifestations as the above :

> Animal sounds are the echoes of blind instincts within, or of the phenomena of the outward world, uttered by suffering or satisfied animal nature, and in all cases resulting from mere passiveness.

By rational language, on the other hand, is signified, to quote Mr. Mivart :[2]

> The external manifestation, whether by sound or gesture, of general conceptions :—not emotional expressions or the manifestations of sensible impressions, but enunciations of distinct judgments as to "the what," "the how," and "the why."

Consequently, as Bunsen declares :

> The theories about the origin of language have fol-

[1] In his paper read before the British Association at Oxford in 1847.
[2] *Lessons from Nature*, p. 89.

lowed those about the origin of thought, and have shared their fate. The materialists have never been able to show the possibility of the first step. They attempt to veil their inability by the easy but fruitless assumption of an infinite space of time, destined to explain the gradual development of animals into men; as if millions of years could supply the want of the agent necessary for the first movement, for the first step in the line of progress! No numbers can effect a logical impossibility. How indeed could reason spring out of a state which is destitute of reason? How can speech, the expression of thought, develop itself in a year or in millions of years, out of unarticulated sounds which express feelings of pleasure, pain, and appetite? The common-sense of mankind will always shrink from such theories.

Bunsen's words were echoed even more forcibly by Professor Max Müller, speaking as President of the Anthropological Section of the British Association at Cardiff in 1889.

What [he asked] does Bunsen consider the real barrier between man and beast? It is language, which is unattainable, or at least unattained, by any animal except man.

You know [he continued] how for a time, and chiefly owing to Darwin's predominating influence, every conceivable effort was made to reduce the distance which language places between man and beast, and to treat language as a vanishing line in the mental evolution of animal and man. It required some courage at times to

stand up against the authority of Darwin, but at present all serious thinkers agree, I believe, with Bunsen, that no animal has ever developed what we mean by rational language, as distinct from mere utterances of pleasure or pain, a subject lately treated with great fulness by Professor Romanes. Still, if all true science is based on facts, the fact remains that no animal has ever found what we mean by a language; and we are fully justified, therefore, in holding with Bunsen and Humboldt, as against Darwin and Romanes, that there *is* a specific difference between the human animal and all other animals, and that that difference consists in language as the outward manifestation of what the Greeks meant by *Logos*.

It is moreover evident that, far from speech having generated reason, as some have preposterously maintained, it is reason which generates speech, no less inevitably than sunlight produces the spectrum when it passes through a prism. The seeming paradox of Wilhelm von Humboldt is in fact a sober truth: "Man is man only through speech, but in order to invent it he must already be man." We have plain evidence that before means for the internal expression of it are found, the mental word (*verbum mentale*) is awaiting them, and that without this it would be as impossible for any sort of rational speech to be produced as for an apple to be grown without an apple-tree.

Evidence to this effect is furnished by recorded instances of persons who from early childhood, or

even from birth, were deaf, dumb, and blind, and appeared to be cut off from all possibility of human converse, the "gates of Mansoul" being thus almost entirely closed. Such are the well-known cases of Laura Bridgman, Miss Keller, and Martha Obrecht, who had been thus afflicted since their earliest childhood, the two first named from the age of two, and the last from that of three years.[1] Also the more recent instance of Marie Heurtin, who was so born, and consequently could not have even the faintest glimmer of any knowledge these senses could convey.[2] Yet, by the exercise of ingenious and unwearied charity, a means of communication was elaborated through the sense of touch, and the souls which had seemingly been buried alive, shewed themselves responsive to such advances,—often astonishingly so,—and revealed their possession of faculties identical with those of their rescuers. We are told, for example, of Marie Heurtin that her intelligence proved to be quick, that she was even "unusually clever, evidently eager for knowledge, and, as sometimes happens, her faculties being prevented by her infirmity from wasting their powers on external objects, were all the more fresh and vigorous." Even more wonderful is the case of Miss Keller, who attained a degree of culture and accomplishment far beyond the common level of those possessing the use of all their senses.

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[1] See Mivart, *Origin of Human Reason*, p. 166.

[2] See Louis Arnould, *Une âme en prison*, and article "An imprisoned Soul," by the Ctesse. de Courson, *The Month*, January, 1902, p. 82.

Somewhat akin to such instances is that of the savages from Tierra del Fuego mentioned above by Mr. Darwin. In their case likewise, when they were brought into communication with people possessed of higher culture than their own degraded race, it was found that the corresponding faculties within them were not dead, or as yet non-existent, but only starved into lethargy; and, the opportunity being given, they speedily caused surprise by unmistakable proofs how closely they resemble ourselves.

Thus we find that in this branch of our enquiry there is one broad fact, which all must recognize and none can deny. No race of men has ever been known which could not speak, nor any race of animals which could, or which had made the first beginnings of intelligent language. Facts being the only groundwork of Science here is undoubtedly something whereon she may build an inference, and this inference will certainly not be that the faculties of men and animals are radically identical. And if we are told, as we constantly are, that it is more truly scientific to admit such identity, should there not be some other facts, still more significant and equally well established, to exhibit on the other side?

But of what character are the arguments actually adduced? It will be sufficient to quote a few which come with the highest authority.

We may start with the almost classical specimen contributed by Mr. Darwin himself.

It does not [he says] [1] appear altogether incredible that some unusually wise ape-like animal should have thought of imitating the growl of a beast of prey, so as to indicate to his fellow monkeys the nature of the expected danger. And this would have been a first step in the formation of a language.

Similarly Professor Whitney writes of some supposed "pithecoid" [2] men:

There is no difficulty in supposing them to have possessed forms of speech, more rudimentary and imperfect than ours.[3]

And so again Professor Romanes: [4]

Let us try to imagine a community considerably more intelligent than the existing anthropoid apes, although still considerably below the intellectual level of existing savages. It is certain that in such a community natural signs of voice, gesture, and grimace would be in vogue to a greater or less extent. As their numbers increased . . . such signs would require to become more and more conventional, or acquire more and more the character of sentence-words.

Of course, as Mr. Mivart replies,[5] there is no difficulty in supposing anything we choose, or in seeing animals in imagination performing feats

[1] *Descent of Man*, i. 57.
[2] i.e. ape-like.
[3] Quoted by Romanes, *Mental Evolution in Man.*
[4] *Ibid.*, p. 371.
[5] *Origin of Human Reason*, p. 385.

which never yet have they been known to achieve in fact. But no amount of such suppositions or imaginations will furnish Science with the scantiest apology for a foothold, nor can the germs of language attributed to pithecoid communities or the sagest of their patriarchs, be considered as of any greater value than the speeches put into the mouths of the animals by Æsop or "Uncle Remus."

It is also to be noticed that in these accounts of the origin of language, the essential element of reason is always quietly smuggled in as a matter of course. Thus Mr. Darwin's wisest of the pithecoids was able to "think of" a device for the information of his fellows. There is not the smallest doubt that any creature which had got so far as *that* would find what he wanted. It is but the old case of the man who was sure he could have written Hamlet had he had a mind to do so. Like him, the ape might have made the invention, if he had a mind to make it;—only he had not got the mind. So too, Professor Romanes' missing links use tones and signs which acquire "more and more" the character of true speech: which could not be unless they contained some measure of that character already. But it is just the first step thus ignored which spans the gulf between man and brute.

There is another factor upon which, in conjunction with these suppositions, great stress is wont to be laid, namely that of time; it being apparently taken for granted that if only time enough be given anything whatever may come about. Thus Professor

Romanes tells us [1] that his imaginary *Homo alalus*, or speechless man, must probably have lived for an "inconceivably long time," before getting far enough on the road towards speech to give him such an advantage as enabled him to crush out his less accomplished congeners; and that even after this point was reached, another "inconceivable lapse of time" must have been required to turn him into *Homo sapiens*, or man as he actually is. Immense intervals, he further tells us, must have been consumed in the passage through various grades of mental evolution; "The epoch during which sentence-words prevailed was probably immense"; "It was not until æons of ages had elapsed that any pronouns arose."

Meanwhile, there is no scrap of evidence that as a matter of fact any thing of all this ever happened at all, and as Bunsen has observed no millions of years, even were millions available at discretion, could ever supply the want of the faculty without which nothing in the way of language could ever be accomplished.

(*c*) *Free-will.*—Here is another human faculty which Du Bois-Reymond declares never to have been accounted for by natural causation, and he greatly doubts whether it should not be classed among the problems that must be for ever insoluble.

Professor Haeckel, as we have seen, gets rid of all difficulties on this score by laying it down that "the freedom of the will is not an object for critical

[1] *Op. cit.* p. 379.

scientific inquiry at all, for it is a pure dogma, based on an illusion, and has no real existence."

It is plain that for his purpose this is the only course possible. If the will be really free, there can be no question of finding a mechanical explanation of it. There is therefore no alternative but to cut the Gordian knot, and to declare that the liberty which the vast majority of men believe themselves to exercise every instant, is proved by Science to be no better than a pure dogma, that is to say, a mere figment.

When we seek for his indication of the line of argument whereby this position is made good, the information supplied is less full than might be desired. He begins[1] with a rather lengthy sketch of the history of controversy in this regard,—which contains the remarkable statement that "Some of the first teachers of the Christian Churches—such as St. Augustine and Calvin—rejected the freedom of the will as decidedly as the famous leaders of pure Materialism, Holbach in the eighteenth, and Büchner in the nineteenth century." Then he proceeds:

> The great struggle between the determinist and the indeterminist, between the opponent and the sustainer of the freedom of the will, has ended to-day after more than 2,000 years, completely in favour of the determinist. The human will has no more freedom than that of the higher animals, from which it differs only in degree, not in kind. In the last [i.e. the eighteenth]

[1] *Riddle of the Universe*, p. 46.

century the doctrine of liberty was fought with general philosophic and cosmological arguments. The nineteenth century has given us very different weapons for its definitive destruction—the powerful weapons which we find in the arsenal of comparative physiology and evolution. We now know that each act of the will is as fatally determined by the organization of the individual, and as dependent on the momentary condition of his environment, as every other psychic activity. The character of the inclination was determined long ago by *heredity* from parents and ancestors; the determination to each particular act is an instance of *adaptation* to the circumstances of the moment wherein the strongest motive prevails, according to the laws which govern the statics of emotion. Ontogeny teaches us to understand the evolution of the will in the individual child. Phylogeny reveals to us the historical development of the will within the ranks of our vertebrate ancestors.[1]

That is all. It is needless to observe that jargon like this proves nothing. Of anything approaching to evidence there is here, manifestly, no vestige, and there is consequently nothing which can avail to win our assent as rational men.

It is likewise obvious that we have here a question

[1] "Ontogeny" signifies the genesis of the individual, "Phylogeny" that of the race. Accordingly, when rendered into ordinary language, declarations such as these, unsupported as they are by any evidence, are found to mean that the development of the individual tells us all about the development of the individual, and the development of the race all about that of the race. Is it really supposed, as it would seem to be, that such points are scientifically settled by translating terms into Greek?

as to which every human being has the means of judging equally with the most eminent man of Science, and modern improvement of the methods and instruments of research leaves us just where we always were. The final evidence on the subject every man has within himself, in the most vital facts of his own experience. Into the philosophy of the matter it is neither necessary nor advisable at present to go. In dealing with profound yet elementary questions, regarding which our means of knowledge are thus simple and direct, men are apt to bewilder themselves when they begin to philosophize, and to persuade themselves that they cannot be sure precisely of those things that are most certain. George Borrow is by no means the only one who has tormented himself with doubts as to his own existence.[1] A still larger number have professed to believe themselves mere machines compelled to go like clocks, and to do only what has been predetermined for them. But such beliefs are for the lecture-room or the study only, and in practical life every one behaves as if both he himself and others—especially others—were responsible for their conduct. So common-sense teaches, than which we shall not find a safer guide. "Sir," said the eminently common-sense Dr. Johnson, "we *know* our will is free; and *there's* an end on't. All theory is against the freedom of the will; all experience for it. . . . But, Sir, as to the doctrine of necessity, no

[1] *Lavengro*, passim.

man believes it. If a man should give me arguments that I cannot answer to prove that I cannot see ; because I cannot answer his arguments, do I believe that I have no eyes ? "

Thus we find once again that the doctrines which some would force upon us in the name of Science, on whatever they are founded, have no basis of fact, and cannot therefore rightly call themselves scientific.

XI

THE ORDER OF NATURE

THAT the world which we inhabit is a *Cosmos*, ruled by law and order, no one has ever attempted to deny. Only because laws are everywhere found awaiting discovery, is natural science a possibility. What such laws really are, we have already considered. They are, as Mr. Lewes puts it, the paths along which the forces of nature travel to their results; and it is only because these forces keep invariably each to its proper path, that we are able to follow them with our minds, either to learn anything concerning them, or to turn our knowledge to practical account. In something of the same manner, it is because we are assured that our railway trains will run on their appointed lines, that we can learn from Bradshaw how to get to Exeter or to Edinburgh;—but the forces of Nature are never derailed. It is, in fact, as we have heard, the first principle of Science, that "the reign of law is universal, the principle of continuity ubiquitous,"—and upon this the validity of all her methods and conclusions wholly depends. It is taken for granted, with absolute confidence, that what is once found to happen

will be exactly repeated in like circumstances,—that the laws experimentally observed, regarding motion, heat, light, sound, chemical combination, electricity, magnetism, and the rest, will be faithfully obeyed, in every minutest particular, as certainly as suns will rise and set, or moons wax and wane. Were it not so, were the forces of Nature to act spasmodically and at random, and did not their common action so result as to establish or subserve other laws of bewildering complexity,—as in molecular dynamics, the mechanism of the heavens, and the processes of organic life,—we could learn no more from the study of nature than from a page of type which had been set up by an idiot, or an anthropoid ape.

Here is another factor in our problem, and one which has from the first attracted the attention of thinking men. No feature of nature impressed them more than this same reign of law and order, apparent everywhere; and on this account they called the world *Cosmos*, instead of *Chaos*. And, since it is self-evident that everything must have a reason for its being, that whatever is not self-existent must have a cause other than itself, they felt compelled to enquire what manner of cause would account for law and order. The like enquiry we have still to pursue, and by methods radically the same as ever; for amid all her discoveries Science has found nothing which does anything whatever to furnish an answer. All that has been done is enormously to multiply the aspects under which the problem presents itself.

It is now not merely in the larger and more obvious operations of Nature that we can trace this marvellous ubiquity of law, but in her most hidden processes and inmost constitution. At every point, we are forced to ask why things should be as they actually are, and how they came to be subject to conditions which they cannot be supposed to have created for themselves. Why, for example, should the ultimate elements of matter,—be they atoms, or electrons, or whatever else,—always and everywhere observe the same rules of the great game in which they serve as counters? Why, to take a concrete instance, should atoms of Hydrogen in Sirius, or in a star of the Milky Way, obey just the same laws as do those with which we make coal-gas or spirit of salt? These various atoms, as Lord Grimthorpe reminds us, have never been within billions of miles of one another. What is the mysterious influence which links them together across the depths of space? That they are so linked is obvious; for if we can ascertain the existence of such a substance in other spheres, it is only because the light it emits, exactly agrees when analyzed in the spectroscope with that of hydrogen flames in our own laboratories. How comes it, again, that the seventy different kinds of atoms, (to speak in round numbers)—are distributed —according to Mendeléeff's periodic law,—among some seven groups or families, the members of each group resembling one another in various particulars, wherein they differ from the rest? Or, to pass from atoms to molecules, (in which atoms of the same or

of different kinds combine, to build up simple or compound substances respectively,)—how is it that molecules of the same kind are always constructed upon exactly the same model, resembling one another far more closely than sovereigns struck from the same die, or different copies of this morning's *Times?* It was in this uniformity of type, character and behaviour, repeated always and everywhere, in instances multiplied "beyond the power of imagination to conceive," that Sir John Herschel [1] saw a feature stamping atoms and molecules as "manufactured articles, and subordinate agents," which, no less than a line of spinning-jennies, or a regiment of soldiers clad in the same uniform, and going through the same evolutions, imply a controlling force directing things according to a definite system.

These and innumerable other particulars of detail has Science added to the problem: but of anything which can supply an answer, she knows no more than did the first man who ever mooted the question within his own soul.

And if in the inorganic world we find food for such considerations, with immensely greater instance are they forced upon us by a study of the organic. Here we enter a new realm of mystery, for the laws we encounter actively energizing at every point, are altogether different from those with which hitherto we have had to deal. The matter which enters into the constitution of living things,

[1] *Preliminary Discourse on the Study of Natural Philosophy*, p. 38.

—animals or plants—is precisely the same as that of which the inorganic world is constituted. No single atom or molecule is found in the one which has not been drawn from the other ;—nor when incorporated in a living structure do atoms or molecules suffer any alteration, or change their nature in any respect, for, says Clerk-Maxwell,[1] throughout all changes and catastrophes these remain "unbroken and unworn." Nevertheless, they fall at once under the spell of a force which introduces into their operations an order altogether new, for it somehow strikes across all the laws of dead matter, setting up a new code of its own, which endures just so long as life lasts, and is never met with apart from life. And these organic laws issue in marvellous results. Professor Haeckel himself, after endeavouring to show that from the inorganic world no arguments can be drawn to favour the supposition of design in Nature, thus continues:[2]

> But the idea of design has a very great significance and application in the *organic* world. We do undeniably perceive a purpose in the structure and in the life of an organism. The plant and animal seem to be controlled by a definite design in the combination of their several parts, just as clearly as we see in the machines which man invents and constructs ; as long as life continues, the functions of the several organs are directed to definite ends, just as is the operation of the various parts of a machine.

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[1] *British Association Lecture*, 1873.

[2] *Riddle of the Universe*, p. 93.

How Haeckel proceeds to argue that such appearance of purposive design is merely fallacious, we need not here stay to enquire; our present concern is to attempt to realize the evidence of law and order which the world everywhere exhibits. As we have just heard, the parts of an organism, like those of a motor-car, or a chronometer, combine their operations for the production of definite ends; the attainment of which depends in all instances upon the nicest correspondence of various details of their work. Thus, that there should be eyes capable of seeing, the laws of optics must be satisfied, reflection, refraction and the rest, just as exactly in the making of an eye as in that of a telescope. *De facto* they *are* satisfied. The eye, Mr. Darwin styles[1] "a living optical instrument as superior to one of glass as the works of the Creator[2] are to those of man." He speaks, moreover, of "all its inimitable contrivances for adjusting the focus to different distances, for admitting different amounts of light, and for the correction of spherical and chromatic aberration."[3] Therefore, however we are to account for them, the laws which govern

[1] *Origin of Species* (5th Edition), p. 226.

[2] Afterwards (April 17, 1863) Mr. Darwin wrote to Sir J. D. Hooker, "I have long regretted that I truckled to public opinion, and used the Pentateuchal term of creation, by which I really meant 'appeared' by some wholly unknown process."

[3] At a later period Mr. Darwin modified his views as to what he still termed "that wondrous organ the human eye," writing thus (*Descent of Man*, ii. 166): "We know what Helmholtz, the highest authority in Europe on the subject, has said about the human eye: that if an

the production of eyes successfully solve a practical problem and satisfy laws which were in force before an animal with eyes appeared on earth.

In just the same way, the requirements of sound

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optician had sold him an instrument so carelessly made, he would have thought himself fully justified in returning it."

It is perfectly true that Helmholtz so expressed himself (*Vorträge und Reden*, i. 253, etc., English Edition, "*Popular Scientific Lectures*," pp. 219, etc.), adding that "the eye has every possible defect that can be found in an optical instrument, and some which are peculiar to itself." These utterances are frequently quoted, but Helmholtz says a good deal more of which we do not usually hear. He observes, in the first place, that in speaking as above he did so "from the narrow but legitimate point of view of an optician." Having then enumerated all the defects in question, he continues—"In an artificial camera, all these irregularities would be exceedingly troublesome. In the eye they are not so, so little troublesome, indeed, that it was occasionally a matter of extreme difficulty to detect them." He adds that men in general not only are unaware of the existence of such defects, but can hardly be induced to credit it. Also that they "almost always affect those portions of the field of vision to which at the moment we are not directing our attention." What is still more to the point, he observes, that the defects noted are all theoretical, while the purpose of the eye is practical, and that if theoretically more perfect as an optical instrument, it would be practically less serviceable. To complain that the eye is not adapted for the special purposes of a microscope or telescope is like condemning the boats of a sea-going ship because they lack some of the qualities found in racing outriggers or Rob Roy canoes. "As concerns the adaptation of the eye to its functions, [adds Helmholtz,] this is most thorough, and is manifest in the very limitations set to its defects. . . . A man of any sense would not chop firewood with a razor, and we may assume that any elaboration of the optical structure of the eye would have rendered it more liable to injury and slower in its development." Helmholtz therefore concludes that the eye is a product which "the wisest Wisdom may have pre-designed."

It thus comes very much to Pope's solution:

> Why has not man a microscopic eye?
> For this plain reason: man is not a fly,—

and in view of his subsequent admissions, Helmholtz's flourish about returning the eye to its maker looks very like theatrical clap-trap, unworthy of such a man.

are met by the structure of the ear, which Sir Henry Holland, for example,[1] judged more wonderful than that of the eye itself.

So again as to wings. They are in the first place such marvellous pieces of workmanship that as Mr. Pettigrew writes concerning one of their forms.[2] "There are few things in nature more admirably constructed than the wing of a bird, and perhaps none where design can be more readily traced." But, moreover, wings entirely different in plan, as of birds, bats, and all the varieties of insects, alike satisfy the laws of aerostatics, and successfully solve in practice the problem of flight, a problem which we are unable to solve even theoretically. "It is evident," writes Lord Grimthorpe,[3] "that nobody yet thoroughly understands the whole theory of flying, though we are seeing it continually, and have unlimited opportunities of examining all sorts of wings. The explanation that appears plausible for one kind, not only will not do for another but seems refuted by it." Yet in a multitude of different ways, the forces of Nature succeed in effecting what with all our Science we cannot shew to be possible.

And concerning not merely one portion of a creature's structure, but the whole, Professor Huxley declares: [4]

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[1] *Life of C. Darwin*, ii. 234. Erasmus Darwin to C. Darwin, November 23, 1859.

[2] *Animal Locomotion* (International Scientific Series), p. 180.

[3] *Origin of Laws of Nature*, p. 69.

[4] *Lectures on Evolution* (Cheap Edition), p. 37.

The horse is in many ways a remarkable animal; not least so in the fact that it presents us with an example of one of the most perfect pieces of machinery in the living world. In truth, among the works of human ingenuity it cannot be said that there is any locomotive so perfectly adapted to its purposes, doing so much work with so small a quantity of fuel, as this machine of Nature's manufacture—the horse.

These are but a few out of countless similar examples. "We are constantly discovering," says Lord Grimthorpe, "new complications and processes, and what to all common sense appear contrivances, in the organs of all living things, and indeed we can find no limit to them." In all these cases an instrument is fashioned precisely adapted to the performance of a certain function, and it is therefore obvious on first principles that there must exist *some* power capable of producing such instruments.

It will probably be answered that there are forces enough in Nature to account for everything, and that these furnish the needful explanation. But, as Mr. Croll rightly insists,[1] Force by itself explains nothing. Its mere exercise has no tendency whatever to produce such effects. There must likewise be Determination of Force in the one definite direction required, and it is in the source of this Determination that the true cause must be sought to which the result is due. It is not simply because

[1] *Philosophical Basis of Evolution*, passim.

iron is hammered and filed that a railway-engine is produced; nor is it sufficient that a block of marble be chipped with mallet and chisel in order to obtain a statue of Apollo. Unless some influence comes in to direct the forces in such cases to their respective results, the results will never by any possibility be secured. And in the processes of Nature such direction or determination must be exercised in particulars inconceivably intricate, to which the works of man furnish no parallel. As Mr. Croll writes:

If a tree is to be formed, the lines of least resistance must all be determined and adjusted in relation to the objective idea of the tree; of the root; of the branches; of the leaves; of the bud; of the fruit; and of every part of the tree. But this is not all: the tree is built up molecule by molecule, each of which requires a special determination, and, beyond all this, we have the structureless protoplasm, which must be differentiated according to the objective idea of the whole. What produces this marvellous adjustment of means to ends?

And as he insists in another passage:

The determinations which take place in nature occur not at random, but according to a plan—an objective idea. Thus the question is not simply what causes a body to take some direction, but what causes it to take, among the infinite number of possible directions, the proper direction in relation to the idea. In the formation of, say, the leaf of a tree, no two molecules move in identically the same direction or take identically the

same path. But each molecule must move in relation to the objective idea of the leaf, or no leaf would be formed. The grand question, therefore, is, What is it that selects from among the infinite number of possible directions the proper one in relation to this idea?

And this sort of thing is going on in every blossom and leaf and blade of grass, in every hair and every feather over the surface of the earth.

Truly does our author find here "The Grand Question," for in it we touch the very heart of our whole problem, and are forced to consider more closely than we have hitherto done of what character must be the ultimate Cause which alone can explain the world.

It is, as we have seen, a first principle of Science, that in enquiries such as this, we must proceed from experience to inference, from the known to the unknown. Arguing thus, we may legitimately gather from observed phenomena, that something exists, which even though it be not directly within the range of our senses, must certainly be capable of producing such phenomena: just as the perturbations of one planet have revealed the existence of another; and the lines in their spectra have taught us the chemical constitution of the sun and stars.

This principle being borrowed by Science from common-sense, has instinctively been ever adopted by those who set themselves to enquire of what kind must be that unseen Power at the back of Nature to which the fact of law and order may

be ascribed. And as there is but one force or power within the range of our experience capable of producing such an effect, it is but natural that this should have been constantly assumed to represent, at least by analogy, the nature of the power required. That there is but one cause known to us experimentally, which can determine the operation of force towards the attainment of a preconditioned result, none will deny—namely the purposive action of an intelligent will, as known to us in ourselves and in our fellow-men;—and to Will accordingly, immensely more intelligent than ours, has been ascribed the establishment of those laws which the highest intellects of our race are able partially and dimly to apprehend.

It is thus that we are led to the fundamental doctrine of Theism, to belief in an intelligent First Cause, according to whose design the universe has been fashioned; a cause which must have all that is found in the universe or any part of it, including man, and more—for it has of itself what all else derives from it—whose purposes necessarily transcend our mental grasp—but whose modes of thought are reflected in our own, by which they can in some measure be followed through a study of their results.

If such a belief, so grounded, be unscientific, as is constantly assumed, there must be good arguments to the contrary. It should be demonstrable, either that Science has shown such a line of reasoning to be unsound, or that she has discovered

within her own domain something which, at least conceivably, can do the work thus attributed to Intelligence—in which case the much-quoted dictum of Lord Kelvin will be in point,—that if a probable solution of any problem can be found which is consistent with the ordinary course of Nature, we must not go beyond Nature in search of one.

If, on the other hand, the above line of reasoning cannot be invalidated, and if scientific methods can discover nothing competent to effect what has undoubtedly been effected, it is not easy to see how it can be unscientific to proceed by inference to what is confessedly beyond the scope of observation and experiment.

That "Teleology," or the doctrine of Final Causality,[1] is unworthy of serious consideration, is without doubt a common assumption, and some writers seem to think that an argument is sufficiently discredited if it be styled "teleological." Yet this rather formidable term represents no more than the belief that the infinite adaptations of means to results observed in Nature are the effect of purpose, not of chance. And if we eliminate purpose, what is there left to furnish an explanation, beyond the indubitable fact that such adaptations have always been found in organic nature, and that we have learnt confidently to anticipate that they will

[1] By a *Final Cause* is meant the predetermined result or end, towards which a work of intelligence is directed, the end being the ultimate cause of the whole act. Thus the obtaining a light is the *Final Cause* of striking a match: while the striking of the match is the *Efficient Cause* producing the light.

appear generation after generation according to the "law of heredity"? But this obviously only tells us that they have been produced and are likewise transmitted, and throws no light whatever on the cause of the marvellous processes to which their production and their transmission are due. If we have any rational grounds for expecting that such processes will continue to occur, it cannot be merely that they have occurred before, but we instinctively infer that the cause to which they are ultimately due continues to operate. We are thus as far as ever from an answer to the question, What is that cause?

> It may be urged [says Newman][1] if a thing happens once it must happen always; for what is to hinder it? Nay, on the contrary, why, because one particle of matter has a certain property, should all particles have the same? Why, because particles have instanced the property a thousand times, should the thousand and first instance it also? It is *prima facie* unaccountable that an accident should happen twice, not to speak of it happening always. If we expect a thing to happen twice, it is because we think it is not an accident, but has a cause. What has brought about a thing once, may bring it about twice. *What* is to hinder its happening? rather what is to make it happen? Here we are thrown back from the question of Order to that of Causation. A law is not a cause, but a fact; but when we come to the question of cause, then we have no experience of any cause but Will.

[1] *Grammar of Assent*, p. 69.

Here is the crucial point: "We have no experience of any cause but Will;" and it follows that if, as Science bids us, we base inference on experience alone, there can be no doubt about the conclusion to which we shall be led.

No different is the verdict of Sir John Herschel:

The presence of *Mind* [he writes][1] is what solves the whole difficulty: so far, at least, as it brings it within the sphere of our consciousness, and into conformity with our own experience of what action is.

That the introduction of intelligent purpose, as a factor, sufficiently meets the requirements of our reason cannot be denied. As Bishop Butler insists, it is even impossible for any man in his senses to say that the problem can be more easily solved without it. And witnesses not merely unfriendly, but positively and even bitterly hostile, are compelled to admit that on whatever other grounds they may reject Theism, it is not because this doctrine is inadequate as an explanation of the world we know.

It seems to me [says Professor Huxley][2] that "creation," in the ordinary sense of the word, is perfectly conceivable. I find no difficulty in imagining that, at some former period, this universe was not in existence; and that it made its appearance . . . in consequence of the volition of some pre-existent Being.

[1] *Familiar Lectures*, p. 458.

[2] "On the Reception of the 'Origin of Species,':" *Life of C. Darwin*, ii. p. 187.

The so-called *à priori* arguments against Theism, and given a Deity, against the possibility of creative acts, appear to me to be devoid of reasonable foundation.

Similarly, that uncompromising foe of religious belief in any shape, Professor W. K. Clifford, replying to Dr. Martineau who based his argument on the existence of the moral law, as well as the evidence of design in Nature, wrote thus : [1]

> I fully admit that the theistic hypothesis, so grounded, and considered apart from objections elsewhere arising, is a reasonable hypothesis and an explanation of the facts. The idea of an external conscious being is unavoidably suggested, as it seems to me, by the categorical imperative of the moral sense ; and moreover in a way quite independent, by the aspect of nature, which seems to answer to our questionings with an intelligence akin to our own.

On the other hand, where is an alternative hypothesis to be found of which as much can be said,—which will justify itself to reason, by accounting for the facts ? That no purely materialistic or mechanical theory will suffice is not only obvious to common-sense, but is acknowledged by those who would gladly find such a theory sufficient.

> It would be a great delusion [writes Weismann] [2] if

[1] *Nineteenth Century*, No. 2. Reprinted in *Lectures and Essays*, p. 388 (2nd Edition).

[2] *Studies in the Theory of Descent*, vol. ii. p. 710 ; *vid. Edinburgh Review*, October, 1902, *The Rise and Influence of Darwinism.*

any one were to believe that he had arrived at a comprehension of the universe by tracing the phenomena of Nature to mechanical principles. He would thereby forget that the assumption of eternal matter with its eternal laws by no means satisfies our intellectual need for causality.

Similarly, Professor Huxley admits that even his primeval cosmic nebula with the world potential in its womb, leaves something to desire.

The more purely a mechanist the speculator is [he writes][1] the more firmly does he assume a primordial molecular arrangement of which all the phenomena of the universe are the consequences, and the more completely is he thereby at the mercy of the teleologist, who can always defy him to disprove that this primordial molecular arrangement was not[2] intended to evolve the phenomena of the universe.

Accordingly, although he was clearly persuaded that Theism is a doctrine which we can never have sufficient grounds for accepting, Professor Huxley repudiated the notion that scientific discovery has done anything to disprove it. Thus he tells us,[3] that, in order to be a teleologist, and yet accept Evolution, it is only necessary

[1] *Ut sup.* p. 201.

[2] *Sic.* The sense evidently requires either that the "not" should be deleted, or "prove" be substituted for "disprove" in the preceding line. This erroneous reading occurs not only in the text from which I quote, but likewise in the *Critiques and Addresses*, p. 307, where this passage forms part of the Professor's review of Haeckel's *Natural History of Creation*, under the title of *The Genealogy of Animals*.

[3] *Life and Letters*, ii. 195.

to suppose that the original plan was sketched out . . . that the purpose was foreshadowed in the molecular arrangements out of which the animals have come.

And again,[1] he thus expressed himself regarding two objections commonly brought against Darwinism, namely that it introduces "chance" as a factor in nature, and that it is atheistic:

Both assertions are utter bosh. None but parsons believe in "chance"; and the philosophical difficulties of Theism now are neither greater nor less than they have been ever since Theism was invented.

Accordingly, as has already been urged, in regard of this question we are precisely where men have always been,—dependent upon arguments such as satisfied philosophers like Cicero, who declared that when we regard the starry heavens the existence of a Deity of surpassing intelligence must appear no less obvious than that of the sun in the sky.[2]

That scientific enlightenment is not incompatible with such reasoning, we have sufficient evidence in the fact that amongst those whose conclusions are wholly in accord with Cicero's, men are to be found standing in the very front rank of Science.

Like the Roman orator, Sir Isaac Newton declared that the existence of a Being endowed with intelligence and wisdom is a necessary inference from a study of celestial mechanics, and that to treat of God is therefore a part of Natural Philosophy.[3]

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[1] *Ibid.*, p. 467. [2] *De Natura Deorum*, ii. 4.

[3] *Principia, Schol. Gen.*

We assume, as absolutely self-evident [say Professors Stewart and Tait][1] the existence of a Deity, who is the Creator and Upholder of all things.

When we contemplate the phenomena of vision, [says Sir G. G. Stokes,][2] it seems difficult to understand how we can fail to be impressed with the evidence of design thus imparted to us. But design is altogether unmeaning without a designing mind. The study then of the phenomena of nature leads us to the contemplation of a Being from whom proceeded the orderly arrangement of natural things that we behold.

Lord Kelvin's recent declaration is even more vigorous.[3]

I cannot say that with regard to the origin of life Science neither affirms nor denies creative power. Science positively affirms creating and directive power, which she compels us to accept as an article of belief.

Thirty years earlier Clerk-Maxwell in concluding his famous lecture before the British Association[4] thus spoke concerning Molecules:

They continue this day as they were created, perfect in number and measure and weight, and from the ineffaceable characters impressed on them we may learn that those aspirations after accuracy in measurement, truth in statement, and justice in action, which we reckon

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[1] *Unseen Universe*, p. 47.

[2] *Burnett Lectures*, p. 327.

[3] See report of his words emended by himself, *Nineteenth Century and After*, June, 1903.

[4] Bradford, 1873.

among our noblest attributes as men, are ours because they are essential constituents of the image of Him who in the beginning created, not only the heaven and the earth, but the materials of which heaven and earth consist.

It is of course not to be denied that there are eminent men of science who altogether dissent from such opinions, and reject Theism as false, or at least as lacking any rational claim on our acceptance. That, however, is not the point. The above testimonies have not been adduced as if their authority could settle the question, which is one to be determined not by authority, but by argument. At the same time, it is abundantly evident that it is not argument but supposed authority which influences the great majority of those who style themselves rationalists. By what modes of reasoning their creed is supposed to be established they have usually little idea: but they firmly believe, as they are constantly assured, that no one who knows what Science is can pretend to credit an antiquated doctrine which she has entirely exploded. It is to show what degree of truth attaches to such statements, that our witnesses have been called—and for this purpose their testimony is undoubtedly sufficient. As Lord Rayleigh in his Presidential address told the British Association: [1]

It is true that among scientific men, as in other

[1] Montreal, 1884.

classes, crude views are to be met with as to the deeper things of Nature; but that the life-long beliefs of Newton, of Faraday, and of Maxwell, are inconsistent with the scientific habit of mind, is surely a proposition which I need not pause to refute.

And when from authority we turn to the line of argument adopted by those who would impugn that upon which Theists rely, and who reject the idea of an intelligent First Cause either as superfluous, or as incapable of verification, we find but two courses one or other of which they feel themselves compelled to adopt, although it is not very easy to understand the state of mind which can rest satisfied with either.

Some, on the one hand, frankly admit that Science has not by her own proper methods discovered any ultimate principle of things, and never will. But on that very account, they maintain, this ultimate principle, whatever it may be, must remain utterly unknown to us—for we can never *know* anything except by the methods of Science. Accordingly, although the theistic hypothesis would confessedly furnish such an explanation as is lacking, we must not adopt it because we cannot test it experimentally.

And yet in ordinary life we have no difficulty in arguing from effect to cause in just the same manner, and satisfying ourselves of the existence of what we can as little touch or see as the First Cause itself. Thus we are convinced of the genius of Shakespeare

and Napoleon, and that there was a difference between the character of Robespierre and that of Howard the Philanthropist. But no man ever saw or touched either genius or character, which can be known only by their results. It is by inference far less legitimate that those proceed who, like Haeckel, seek in the forces of Nature themselves an explanation of phenomena which, as we know them, they are wholly incapable of producing. Instead of arguing that a cause must therefore exist which is beyond Nature, but whose character our own experience enables us in some measure, and analogically, to learn, these philosophers start with the assumption that no such cause is possible, and then proceed to draw the consequence that the condition of Nature must once have been totally different from what it actually is, enabling her forces to produce results which no experience of any sort indicates as possible.

Those who adopt such an attitude of nescience, and in the proper sense of the word are termed Agnostics, find themselves compelled accordingly to leave their system in the air, with no basis more solid than the elephant and tortoise on which Hindoo astronomers rested the world. They must ignore the fundamental principle of Causation, from which we started our present enquiry, and in consequence it is impossible that their systems should, as Professor Weismann says, satisfy our intellectual needs.

Others, on the other hand, declare that the

Theistic hypothesis must be dismissed, because a better has been found, Science having discovered within her own sphere an effectual substitute for the supposed First Cause. When we enquire what this may be, we are told that it is the "Law of Substance," or "Evolution," or "Nature" herself, or an "Infinite Eternal Energy unknown and unknowable," but devoid of intellect and will—or "Monism," or some other similar abstraction which can represent no idea at all, unless—as often happens—it be clad in the robes of its rival, and credited with the very powers and attributes denied to the First Cause, so as to become practically the same thing under another and misleading name. Regarding this point there will be more to be said presently. Here, it will be sufficient to note that this is in truth the only meaning which can be attached to much of the language of so-called scientific writers.

> Who [asks Mr. Wollaston][1] is this Nature . . . who has such tremendous power, and to whose efficiency such marvellous performances are ascribed? What are her image and attributes when dragged from her wordy lurking-place? Is she aught but a pestilent abstraction, like dust cast in our eyes to obscure the workings of an intelligent First Cause?

So at the end of his life Clerk-Maxwell characteristically observed, that he had studied many queer

[1] *Annals and Magazine of Natural History*, 3rd Series, vol. v. p. 138.

religions and philosophies, but had found none of them that would work without God concealed somewhere.

Finally, a warning uttered by Lord Rayleigh in the address quoted above must not be forgotten. After acknowledging that "unfortunately" there are writers speaking in her name who have set themselves to foster the prevailing belief that Science necessarily tends towards materialism, he thus continued:

> It would be easy, however, to lay too much stress upon the opinions of even such distinguished workers as these. Men who devote their lives to investigation cultivate a love of truth for its own sake, and endeavour instinctively to clear up, and not, as is too often the object in business and politics, to obscure, a difficult question. So far the opinion of a scientific worker may have a special value; but I do not think that he has a claim superior to that of other educated men, to assume the attitude of a prophet. In his heart he knows that underneath the theories that he constructs there lie contradictions which he cannot reconcile. The higher mysteries of being, if penetrable at all by the human intellect, require other weapons than those of calculation and experiment.

XII

PURPOSE AND CHANCE

An objection is no doubt awaiting us which many consider absolutely fatal to the argument for purpose or design in nature, as above presented. That argument, it will be said, rests entirely upon the assumption that the sole alternative to Purpose is *Chance*, an assumption which, if not dishonest, betrays ignorance scarcely less discreditable: for men of science constantly warn us that there is no such thing as Chance,—that every occurrence in nature, one as much as another, testifies to the uniformity and regularity of natural causation,—and that if we speak of any phenomenon being due to Chance, this term is but a conventional symbol signifying that we do not know what caused it.

Amongst those who take up this position, which is well-nigh universal, no better representative need be sought than Professor Huxley, who treated the point formally, and was manifestly well satisfied with his performance. We have already heard him declare belief in Chance to be an absurdity of which none but parsons could be guilty, a class in which he clearly conceived the low-water-mark of intelli-

gence to be reached. On another occasion,[1] he set himself expressly to the exposure of what he described as, "The most singular of the, perhaps immortal, fallacies, which live on, Tithonus-like, when sense and force have long deserted them."

Probably the best answer [he writes] to those who talk of Darwinism meaning the reign of "Chance," is to ask them what they themselves understand by "Chance." Do they believe that anything in this universe happens without reason or without a cause? Do they really conceive that any event has no cause, and could not have been predicted by any one who had a sufficient insight into the order of Nature? If they do, it is they who are the inheritors of antique superstition and ignorance, and whose minds have never been illumined by a ray of scientific thought.

As an object lesson for his enlightenment, the Professor bids one of these benighted folk betake himself to the sea-shore on which a heavy storm is breaking; and having painted a rather elaborate word-picture of the scene, he thus continues:

Surely here, if anywhere, he [the unenlightened one] will say that chance is supreme, and bend the knee as one who has entered the very penetralia of his divinity. But the man of science knows that here as everywhere, perfect order is manifested; that there is not a curve of the waves, not a note in the howling chorus, not a rainbow-glint on a bubble, which is other than a neces-

[1] "Reception of 'Origin of Species,'" *ubi sup.* p. 199.

sary consequence of the ascertained laws of nature; and that with a sufficient knowledge of the conditions, competent physico-mathematical skill could account for, and indeed predict, every one of these "chance" events.

This, however, is mere beating of the air, having no bearing whatever upon the question at issue; and we can only wonder that so able a man as Huxley could thus absolutely miss the whole point, while remaining serenely unconscious that he did so. No sane man ever entertained the foolish notion with which he credits his man of straw. On the contrary, it is precisely those whom he so heartily despises, that *dis*believe in Chance, and deny it any share in the making of the world. They neither regard Chance as a possible cause of phenomena, nor make of it a kind of deity or fetish, as some appear inclined to do with Science. Their contention is that according to those who, with Huxley, reject the idea of intelligent purpose, Chance would needs be introduced as a ruling element in nature, which would be absurd. Nor in thus arguing do they introduce any notion so irrational as that of "absolute" Chance, of events happening without causes. But unquestionably there can be "relative" Chance. A cause fully sufficient for the production of a result, may have no tendency whatever to determine or direct this result to a particular end; and if in such circumstances this end be attained it is by Chance. In particular, should many indepen-

dent results of purely mechanical forces combine to produce a result, as intelligence would combine them, its production can only be ascribed to Chance. "Chance" has therefore a very real meaning. It is not a Cause, but the absence of Cause: not of Cause altogether, but of the *determining* Cause requisite for the production of certain results. The argument based upon the impotence of Chance to obtain such results, is precisely that which the most exact of all the Sciences, Mathematics, accepts and applies in the Theory of Chances.

The answer to the question which Professor Huxley evidently deems unanswerable is plain enough. By "Chance" is meant the concurrence, unguided by Purpose, of independent forces to produce a definite effect. "Chance" denotes the absence of Purpose, as "Vacuum" denotes the absence of air; and when it is denied that certain results can come about by chance, or fortuitously, it is as when we deny that life can be sustained *in vacuo*. It is no positive feature or action of the vacuum that we have in mind, for its essence is negative; but just because of that negative character, experience has taught us, that it cannot fulfil certain functions. In the same manner the potency of "Chance" is denied, simply because it is not Purpose.

That there are phenomena for which "Chance" thus defined cannot account is, surely, obvious. If a man sits down at a piano and plays "God Save the King," no evidence in the world would persuade

Professor Huxley or any one else, that the performer had never before seen a musical instrument, nor knew of the existence of such an air or any other, but just put his fingers on the keys as the spirit moved him. Such a story would be rightly felt to be absolutely incredible: and yet the notes he produced—equally with those of the howling chorus of winds and waves—were the necessary effects of physical causes; given that particular strings were struck, they could not but follow. The whole point is, however, that in this case the result is *not* a howling chorus, but a melody; not mere formless noise, but an orderly composition, constructed on definite principles which our mind can recognize. It is in regard of this particular feature of the result that Force of itself, as we have seen, explains nothing, and that, if there is to be any explanation at all, we must know something as to how Force received the needful Direction or Determination.

It is only in regard of human action that we can, as in the above instance, find an example of what may be called pure fortuity, for such action alone can be traced up to an initial cause, namely the exercise of Will. No one can have a right to call the action of natural forces fortuitous; on the contrary, we have seen arguments that in the inorganic world itself purpose must be recognized. But an action directed by purpose to one result may be quite fortuitous in regard of another. A man who digging a foundation for a house finds a buried treasure, discovers this by chance. Although his

action was ruled by a most definite purpose, that purpose was not this. So again when, according to the old story, certain Phœnician mariners finding no stones on the sea-shore suitable for the purpose, used blocks of natron to support their cooking-pots, and so produced glass, they were led to the discovery by mere chance. And in like manner, however definitely the forces of matter may be determined each to its own proper end, there are results which if produced by them must be as purely fortuitous as such an invention made by men who thought only of preparing their dinner. The cable which was being laid to America having, in 1865, snapped and sunk in mid-Atlantic, it was determined in the following year to attempt its recovery. Meanwhile the shore-end at Valencia was still connected with the dial-plate, on which messages had been scored between ship and shore while the cable was intact. A telegraphist was constantly on duty, watching the needle which was never still, being deflected hither and thither by the earth-currents, working through the wires. On a sudden, however, the needle spelled out the letters "Got it," and it was known with absolute certainty that there was a man at the other end. It is no doubt perfectly true that each previous movement had been the necessary consequence of the force applied, just as truly as those which coincided with the conventions of the telegraphist's alphabet; but will any one say that such coincidence could conceivably be attributable to the forces of mag-

netism alone, however exact to the laws according to which they operate ?

It must always be remembered that the question we have to discuss is, how far Science casts any light upon such questions as the one before us. And since "Science" is taken to mean knowledge acquired through the observation of phenomena alone, we have at present to enquire whether material forces, the only ones of which observation directly tells us anything, could have produced such effects as we have considered, otherwise than by mere "Chance"? If they could not, is it imaginable that they produced these effects at all? And it appears obvious that unless there be Purpose at the back of Nature, Chance must be acknowledged as the architect of the universe.

Professor Huxley tells us, it is true, that such an idea could be entertained by no one whose mind had ever been illumined by a ray of scientific thought. In face of this it is rather remarkable to find that the idea was undoubtedly entertained by Mr. Darwin, who took for granted that to deny Purpose is to affirm Chance.

> I am conscious [he wrote to Asa Gray][1] that I am in an utterly hopeless muddle. I cannot think that the world, as we see it, is the result of chance; and yet I cannot look at each separate thing as the result of Design.

[1] November 26, 1860

And again:[1]

> I cannot any how be contented to view this wonderful universe, and especially the nature of man, and to conclude that everything is the result of brute force. I am inclined to look at everything as resulting from designed laws, with the details, whether good or bad, left to the working out of what we call chance. Not that this notion *at all* satisfies me.

Professor Haeckel too is by no means in accord on this point with his friend Professor Huxley. He writes:[2]

> One group of philosophers affirms, in accordance with the teleological conception, that the whole cosmos is an orderly system, in which every phenomenon has its aim and purpose; there is no such thing as chance. The other group, holding a mechanical theory, expresses itself thus: The development of the universe is a monistic mechanical process, in which we discover no aim or purpose whatever; what we call design in the organic world is a special result of biological agencies; neither in the evolution of the heavenly bodies nor in that of the crust of our earth do we find any trace of a controlling purpose—all is the result of chance. Each party is right—according to its definition of chance. The general law of causality, taken in conjunction with the law of substance, teaches us that every phenomenon has a mechanical cause; in this sense there is no such

[1] May 22, 1860. [2] *Riddle of the Universe*, p. 92.

thing as chance. Yet it is not only lawful, but necessary to retain the term for the purpose of expressing the simultaneous occurrence of two phenomena, which are not causally related to each other, but of which each has its own mechanical cause independent of the other. Everybody knows that chance, in this monistic sense, plays an important part in the life of man and in the universe at large. That, however, does not prevent us from recognizing in each "chance" event, as we do in the evolution of the entire cosmos, the universal sovereignty of nature's supreme law, *the law of substance.*

There is a good deal here which is less clear in the way of argument than could be wished. The famous *Law of Substance,* as we have seen, has two articles: The indestructibility of matter, and the conservation of energy. What light either of these principles may be supposed to shed on such questions as the adaptation of organs to their functions is by no means obvious. To say that there is no design in the organic world, because it is a special result of biological agencies,—is quite of a piece with the contention which has actually been made, that we can no longer argue to Design, with Paley, from the analogy of a watch, since "nearly every part of a watch is now made by inanimate machinery."[1] Thus much, however, is perfectly clear: the competence of Chance is recognized to originate a world like ours, and to enable Nature, as Professor Clifford says, seemingly

[1] *The Scientific Basis of Morality,* by George Gore, LL.D., F.R.S., p. 31.

to answer our questionings with an intelligence akin to our own.

It would thus appear that when Newton asks,—Was the eye fashioned without knowledge of the laws of light, or the ear, without knowledge of those of sound ?—we are to answer in the affirmative, and to say that such organs are but special results of biological agencies, under the general management of the Law of Substance.

That such a reply cannot with any truth be termed scientific is plain—for it touches matters which by her own acknowledgment Science cannot reach ;—nor does it seem probable that this kind of talk would convince anybody, were there nothing more. Undoubtedly those who persuade themselves that the Order of the Universe can be sufficiently explained without introducing the idea of purpose or design, are influenced by other considerations than these.

(1) With some it is the argument, which appears chiefly to have weighed with Mr. Darwin, who constantly speaks of it as the great obstacle to that belief in Design which the marvels of the universe would otherwise necessitate. This he based on certain features in Nature which appeared to him incompatible with the work of a beneficent Author, mainly the existence of suffering amongst animals in whose case it cannot be supposed to subserve any purpose of moral benefit. As he wrote to Asa Gray : [1]

[1] May 22, 1860.

I own that I cannot see as plainly as others do, and as I should wish to do, evidence of design and beneficence on all sides of us. There seems to me too much misery in the world. I cannot persuade myself that a beneficent and omnipotent God would have designedly created the Ichneumonidae with the express intention of their feeding within the living bodies of caterpillars, or that a cat should play with mice. Not believing this, I see no necessity in the belief that the eye was expressly designed.

Such a mode of meeting the arguments for Design, though only indirect, undoubtedly deserves serious consideration, touching as it does the darkest of all mysteries—the Origin of Evil. It is clear, however, that in Mr. Darwin's case, and probably in that of many others, its effect was due in no slight degree to imagination rather than to reason. He picks out one or two instances of seeming cruelty in Nature, as though they were something exceptional, and appears to imply that they create an obstacle to a belief which Nature as a whole almost forces upon him. In reality, the same sort of thing goes on everywhere. Animal life from beginning to end is a record of rapine and slaughter, as Tennyson declared in a verse too trite to bear quotation. The most petted of pet dogs has no more compunction than a tiger in worrying creatures weaker than itself, and a robin-redbreast takes far more lives daily than does a sparrow-hawk. But to draw from these facts such large conclusions—is quite another matter. Can we imagine that we are qualified by

the fulness of our knowledge to pronounce judgment and declare that there can be no good end where we fail to perceive one? As Mr. Darwin admits in the very same passage: "I feel most deeply that the whole subject is too profound for the human intellect. A dog might as well speculate on the mind of Newton."

How much is there in the actions of persons much lowlier than Newton which to the most intelligent of animals, dogs, elephants, or monkeys, could they speculate at all, must seem wholly devoid of sense;—as for instance that men should spend such continual labour in digging and ploughing. So again, in his famous lecture on Coal, Professor Huxley depicts what might have been the reflections of a giant reptile of the Carboniferous Epoch, suggested by the seemingly senseless waste of nature's powers in the production of the primeval forests, that have furnished the coal measures, to which so much of our progress and civilization is directly due.

And, after all, given the universal law of death for all living things, it would hardly appear that we can assure ourselves that any attendant circumstance constitutes a greater evil—as Mr. Darwin's argument seems to assume; and yet, it does not appear ever to have been argued that there can be no purpose in Nature since no organic life endures for ever. Most probably, if we knew enough, we should plainly see that nothing could be more cruel than to have omitted the carnivora from creation, leaving herbivorous animals to multiply till they

starved one another to death, or at least to perish of senile decay far more painfully than under the fangs of tigers and wolves. Instances might moreover be quoted which serve to remind us how impossible it is rightly to estimate the true character of suffering amongst creatures altogether different from ourselves. Thus when, as eye-witnesses report, young scorpions clinging to their mother devour her alive, scientifically avoiding as long as possible all vital parts and mortal wounds—we are inclined to consider them monsters of wickedness, and their parent as a model of motherly devotion, whose sufferings cannot be less horrible than those of a caterpillar similarly eaten by the ichneumon grub. But we cannot with any reason impute more moral blame to the young scorpions, than to the lambkins which draw sustenance from their dams in another fashion which we find touching and poetical; while as for the mother—who doubtless treated her own parent in just the same fashion—she exhibits no symptom to show that she resents her offsprings' advances, any more than does the ewe, but on the contrary has her sting ever ready for any one who would interfere with them.

(2) It is a still more common objection to the doctrine of purpose everywhere in Nature, that such an idea is negatived by the continuity and uniformity of natural laws, precluding the notion of constant interference by another, supernatural, Agent. But this objection is based upon an entire misconception. No one imagines such inter-

vention, or that purpose guides nature as a pilot guides a ship by repeated orders to the man at the wheel. Undoubtedly the reign of law in nature is uninterrupted, but in that law purpose is interwoven as the controlling element; just as the mind of Homer governs the hand of every printer who sets up type for a new edition of the *Iliad*.

(3) Finally, there is the argument, already alluded to, that inasmuch as the most complex structures are daily transmitted under our eyes by generation, we have evidence that nature can produce them from her own resources, and by the operation of a merely natural law, such as no one doubts generation to be.

Such an argument, it is evident, merely begs the question at issue, offering as it does no explanation, or suggestion, as to how a power so marvellous was acquired. It would be equally philosophical to argue that there is nothing wonderful about the genius of a great poet because we confidently anticipate that it will be exhibited in the next piece he produces.

It is likewise clear that, here again, imagination rather than reason furnishes the argument. In the first place, were there nothing else, no explanation whatever would thus be afforded as to how the structures in question were first produced, before they could be transmitted. And, secondly, which is still more important, generation—far from furnishing an explanation of anything —introduces us to mysteries yet more inscrutable than any we have yet en-

countered, and to problems which seem to admit of no possible solution apart from, not only Purpose, but transcendent Power.

Doubtless the propagation of life is ruled by natural law, but how such law effects its object we understand immeasurably less than we understand the flight of birds or butterflies. As a recent writer reminds us,[1] what is transmitted from parents to offspring "is not a new form or structure, but only the *potentiality* of such a new form: which, in suitable circumstances, builds *itself* up out of surrounding inorganic and organic material." As Lord Grimthorpe expresses the same truth:[2]

> If we suppose an apple-tree to have once grown somehow, and to have somehow got power to produce seeds, that would not produce any more apple-trees, unless the seeds, and all the adjacent atoms that are wanted, had the power and the will to combine and grow into another apple-tree. The first hen that laid an egg performed a wonderful feat enough, but it would have done no good unless the atoms of the egg also knew and resolved what to do to turn themselves into a chicken. Yet spontaneous evolutionists are in the habit of slurring over generation as a thing too "natural," and therefore too easy and simple to require explanation.

The continual operation of a law such as this, certainly does not remove mysteries, nor make it more easy to understand how the order and the

[1] Bain, *De vi physica*, p. 76.
[2] *Origin of Laws of Nature*, p. 61.

marvels of the universe can rationally be attributed to Chance rather than to Design, according to "this new philosophy of effects without causes and laws without a lawgiver."[1] For "fortuitous" means, as Professor Case has well observed,[2] not the accidental, as opposed to the regular laws of nature, but the spontaneous necessity of nature, as opposed to the voluntary designs of intelligence. Nor is it only in the organic world that we find the need of such a factor to explain phenomena; for it is throughout more essential than any other force to account for Nature as we find her—in such a manner as to satisfy the logical demands of our mind. We learn as little from observation and experiment as to the fundamental laws of matter, —gravitation, for instance, which Faraday and Herschel termed "the mystery of mysteries," or chemical affinities, or the nature of Ether— as concerning anything in organic nature; though in the latter we undoubtedly mount to a higher plane of mysteriousness. And in either case we could learn nothing whatever,—that is to say, Science would be wholly impossible,—did we not find natural phenomena respond to our enquiries with what seems an intelligence akin to our own. And accordingly it appears but reasonable,—that is to say, truly scientific,—to exclaim as did even Diderot—"Quoi! le monde formé prouverait moins une intelligence que le monde expliqué!"

[1] Lord Grimthorpe, *op. cit.* 85.

[2] Letter to the *Times*, June 2, 1903.

XIII

MONISM

ALL systems of philosophy that reject the idea of an intelligent First Cause, which alone is self-existent, and whose being is of a higher order than that of aught else,—base their denial on the assumption that no such distinction of nature either exists or is possible,—that there is but one reality, namely the substance whereof the sensible world consists,—that this has always existed with the same forces it has now, and that it is the source of all phenomena. This assumption of the unreality of whatever is beyond the scope of sense, which has ever been at the bottom of materialistic systems, is now elaborately formulated as a creed, declared by Professor Haeckel and his following to be the only creed which science can tolerate. This is termed *Monism*,—from the Greek *Μόνος*, "single," and is opposed to *Dualism*, or the doctrine that there are two orders of being, or two distinct substances, material and spiritual.[1]

[1] The term *Monism*, invented by Wolf, originally bore a different meaning from that in which Haeckel employs it. It was used to signify equally the materialistic denial of the substantiality of mind, and the idealistic denial of the substantiality of matter. Professor Haeckel, as will be seen, maintains that mind and matter are but two names for one thing.

According to monistic teaching, therefore, there exists but one *Thing*, that which we usually call Matter, but might equally well call Mind,—for all phenomena whatever, whether mental or material, are but various shapes which it assumes, exhibiting diverse aspects of itself. Thus all the objects which appear to have a being of their own, —as the globe we inhabit, the furniture of earth and heaven, we ourselves,—are but the forms momentarily assumed by this protean entity in its ceaseless transfigurations, and have no more existence of their own than the ripples on a pool of water or the faces we see in the fire. It follows that when the particular phase of this basic substance is ended which brings us into being, (or rather which we *are*,) we like everything else, sink into blank nothing,—so that the mighty dead whom nations honour, or the loved ones whose memory we cherish, are blotted out of existence as utterly as the days and nights which made up the span of their lives. But amongst its permutations and combinations this solitary reality can produce the phenomena which we call thought, just as much as those which we call motion, and accordingly the *Aeneid* or *Hamlet* is its work, a mechanical product of evolution, no less than a seam of coal, or an eclipse of the moon.

Such, in outline, is the philosophical system which commends itself, as Professor Haeckel assures us,[1] to all men of science, who combine

[1] *Confession of Faith of a Man of Science* (English translation), p. 60.

the necessary conditions, of scientific knowledge, mental acumen, moral courage, and intellectual independence. It may be rightly described as materialistic pantheism; for while, according to it, everything is equally divine, in the only sense in which anything can be so, everything is likewise equally material, as falling under the category of what we know as matter, and within the direct cognizance of physical science.

Accurately to sketch a doctrine such as this is a task of no slight difficulty. It undoubtedly contradicts the instinctive teaching of our consciousness, so that, as Professor Haeckel admits[1] in the primitive stages of both religion and philosophy Monism is unknown. Moreover, even those who most loudly profess it, have by no means as yet succeeded in realizing their own system, and after having from time to time formally enunciated its articles, proceed forthwith to ignore them, and in the staple of their discourse speak like other men in terms which have no meaning if the tenets of their creed have any. As a natural result their exposition of monistic doctrine is not very easy of apprehension, but it seems to be not unfairly reflected in the above summary.

Professor Haeckel himself thus expounds "that unifying conception of nature as a whole which we designate in a single word as Monism."[2]

By this we unambiguously express our conviction that

[1] *Ibid.*, p. 10. [2] *Ibid.*, p. 3.

there lives " one spirit in all things," and that the whole cognizable world is constituted, and has been developed, in accordance with one common fundamental law. We emphasize by it, in particular, the essential unity of inorganic and organic nature, the latter having been evolved from the former only at a comparatively late period. We cannot draw a sharp line of distinction between these two great divisions of nature, any more than we can recognize an absolute distinction between the animal and the vegetable kingdom, or between the lower animals and man. Similarly, we regard the whole of human knowledge as a structural unity; in this sphere we refuse to accept the distinction usually drawn between the natural and the spiritual. The latter is only a part of the former (or *vice versâ*); both are one. Our monistic view of the world belongs, therefore, to that group of philosophical systems which from other points of view have been designated also as mechanical or as pantheistic.

More concisely and clearly, Professor Romanes tells us:[1]

Mental phenomena and physical phenomena, although apparently diverse, are really identical.

And in a work recently issued for the express purpose of expounding and diffusing the new gospel, we read:[2]

Just as the same particles of matter may at one time form parts of a rose, and at another time parts

[1] *Mind and Motion.*

[2] *An Easy Outline of Evolution*, by Dennis Hird, M.A., Principal of Ruskin Hall, Oxford, p. 184.

of a mushroom, so the same force may at one time strike a church as lightning, and at another time may be the mother-love that rocks the cradle.

If such conceptions are not easy to grasp, there can be no doubt as to the practical conclusions to which they lead. We have already heard from Professor Haeckel that human freedom is an utter delusion. We have likewise seen that the only term in prospect is utter annihilation, which Professor Haeckel endeavours to persuade us is the consummation we ought to wish.

"The best we can desire," he says,[1] "after a courageous life, spent in doing good according to our light, is the eternal peace of the grave. 'Lord give them an eternal rest.'"

It is evident however that in order to secure such a reward it is not necessary to show any courage, or attempt any sort of good-work, for according to him it equally awaits the most selfish and abandoned voluptuary.

Finally,[2]

At our death there disappears only the individual form in which the nerve-substance was fashioned, and the personal "soul" which represented the work performed by this. The complicated chemical combinations of that nervous mass pass over into other combinations—by decomposition, and the kinetic energy produced by them is transformed into other forms of nature.

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[1] *Ibid.*, p. 74. [2] *Confession of Faith of a Man of Science*, p. 51.

Imperial Cæsar, dead and turned to clay,
Might stop a hole to keep the wind away, etc.—

. . . . .

which lines others besides Haeckel are fond of quoting on this subject as if they had any possible connexion with it. It would be more to the point, and far more interesting, were some indication afforded of the chemical equivalent of the qualities which made Cæsar imperial, or those which distinguished the author of the above lines from the bards of our Music Halls. That, when a man is no more, his material part may serve various material purposes, is no more than was known to the first savage who made a drum with his enemy's skin, or used his skull for a drinking-cup.

As has been said, the Monistic philosophy claims to be above all things scientific, and upon this ground are we bidden to accept it. But what is the meaning of this claim? The one argument, apart from mere assertion, brought to show that spirit is not distinct from matter, is drawn from the part undoubtedly played by the brain in the process of thought, though we see far less in this, as in other connexions, than the assertions made by unscientific writers might lead us to imagine. But when all this is most fully acknowledged can it be said that the state of the question is changed from what it was? To listen to Monists, it might be supposed that the intimate connexion

between soul and body is a new discovery, undreamt of in former ages,—and that we have now arrived at a demonstration that it is our material part that actually does our thinking. But, as a matter of fact, like other fundamental questions, this is exactly as it has ever been, and so far as Science is concerned, we are just as much in the dark respecting it as men ever were. Though the philosophers of former days were unaware of all the departmental details of brain activity, they understood as well as we do the essential point, that in our composite nature soul and body form *one* being, whose every operation is of mixed character like itself. The soul alone is the intelligent principle, yet all objects of knowledge must come to it through sense, and in the senses it can be reached only by the mechanical media of light, or sound, or touch. So firm was their grip of this principle that the Schoolmen styled the soul the "substantial form" of the body, and in their mouth this term expressed a union more essential and intimate than modern philosophers can perhaps imagine.

And, on the other hand, have all the results of modern research brought anything to light which tends to show that matter can by any possibility *think?* We are assured on the contrary, upon unimpeachable authority, that however we may succeed in tracing the mechanical processes of sensation to their furthest limit, it remains absolutely inconceivable to us how the gulf is crossed

that lies between this and rational perception. So Professor Tyndall tells us :[1]

The passage from the physics of the brain to the corresponding facts of consciousness is unthinkable. Granted that a definite thought and a definite molecular action in the brain occur simultaneously, we do not possess the intellectual organ, nor apparently any rudiments of an organ, which would enable us to pass by a process of reasoning from one to the other. They appear together, but we do not know why. Were our minds and senses so expanded as to enable us to see and feel the very molecules of the brain, were we capable of following all their motions, all their groupings and electrical discharges, if such there be, and were we intimately acquainted with the corresponding states of thought and feeling, we should be as far as ever from the solution of the problem—"How are these physical processes connected with the facts of consciousness?" The chasm between the two classes remains still intellectually impassable.

With these views Professor Huxley[2] expresses his agreement, and although he contrives to confuse the issue very considerably, as is not unusual when he undertakes to philosophize, he lays down in the clearest possible terms that nothing whatever is *known* as to the connexion of mechanical processes with thought, whence it follows that on this point Science has nothing to tell us.

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1 *Presidential Address, Section A, British Association*, Norwich, 1868.
2 "Mr. Darwin's Critics." (*Critiques and Addresses*, p. 283.)

"I really know nothing whatever [he writes] and never hope to know anything, of the steps by which the passage from molecular movement to states of consciousness is effected."

It should be needless to repeat that if nothing is known regarding all this, it is mere charlatanism to pretend that Science tells us anything about it, and those who make such assertions use words to which no meaning can attach. Unfortunately such a practice is far from uncommon in connexion with these questions. What sense can there be conceivable in the well-known materialistic doctrine that the brain secretes thought, just as the proper organs secrete bile or saliva? Bile and saliva are material substances, with a definite chemical constitution, each adapted to one definite function. But, Thought! It would be as intelligible to talk of secreting the British Constitution, the Steam Engine, and the Differential Calculus.

So much for the sole basis of Monistic argument. When we turn to some other considerations it certainly becomes no easier to understand the claim of Monism to be scientific. In the first place, as we have seen, in order to furnish the system with any semblance of truth, it has been found necessary to attribute to the ultimate elements of matter qualities which all our experience denies them; for Professor Haeckel has told us that "the two fundamental forms of substance, ponderable matter and ether, are not dead, and only moved by extrinsic force, but they are endowed

with sensation and will." Of such attributes, and that of self-mobility, it is unnecessary to add anything to what has been said already. Assuredly nothing can look less like the great ultimate reality, of whose ceaseless metamorphoses, we are but a flitting phase, than the material substances with which we can do what we like, investigating their laws, exploring their constitution, and setting them tasks which we know exactly how they will accomplish.

Another point in the same connexion is no less important. What is this one *Thing*, this Ultimate and Solitary Self-existent Reality, from which Monism takes its title? Professor Haeckel has told us of two fundamental forms of substance,—ponderable matter and ether. These he evidently supposes, as his creed requires, to be radically the same: but what right has he to take such a supposition for a fact? and unless this unity be a fact, what becomes of Monism? What has Science ever discovered that can justify any one in speaking of Ether and Matter as one and the same? How, then, can a theory that assumes their identity be termed "scientific?"

Or, leaving Ether alone, "that half-discovered entity," as Lord Salisbury styled it on a famous occasion, and restricting our attention to ponderable matter, concerning which we know a little more,—how can even this be spoken of as "One"? As we have seen already it is only by a figure of speech that the term "Matter" can be used at all.

It stands not for a single thing, but for countless millions and billions of atoms, dispersed through space, some of one kind some of another, no one of which can be imagined to owe its existence or its properties to any other. To say that matter is self-existent is to say that every several atom is self-existent. If this be so, and if this be the ultimate Reality,—then there are as many first principles, or first causes, as there are atoms. Yet none of these could do anything to the purpose towards the evolution of anything, without the concurrence of a multitude of others, nor would such concurrence be possible but for the reign of law, which none of them can have instituted, but to which all alike are subject. Were matter the great reality, even matter composed of "animated atoms," the term *Monism* would be sadly out of keeping, and should yield its place to *Myriadism*. If, on the other hand, there *is* a unifying principle amid such diversity, this it must be which can control and direct all to one end.

It is undoubtedly hard to understand how the First Principle of all things can be supposed to consist of Atoms, but this is one of the perplexities in which monistic doctrines abound. That atoms *are*, so far as we know, the ultimate constituents of the Fundamental Reality, Professor Haeckel admits. It is true, he adds, that our knowledge of these ultimate elements is still far from satisfying, and he likewise anticipates that atoms will some day be discovered not really to be ultimate, but forms of something, more primal still.

Although [he says][1] Monism is on the one hand for us an indispensable and fundamental conception in science, and although, on the other hand, it strives to carry back all phenomena, without exception, to the mechanism of the atom, we must nevertheless still admit that as yet we are by no means in a position to form any satisfactory conception of the exact nature of these atoms, and their relation to the general space-filling, universal ether. Chemistry long ago succeeded in reducing all the various natural substances to combinations of a relatively small number of elements; and the most recent advances of that science have made it in the highest degree probable that these elements . . . are themselves in turn only different combinations of a varying number of atoms of one single original element. But in all this we have not as yet obtained any further light as to the real nature of these original atoms or their primal energies.

From which it is clear, that, while the considerations above presented lose none of their force, the Monistic system, by the avowal of its chief apostle, is based on complete ignorance concerning all which could furnish it with a foundation.

But by far the most serious consideration yet remains. If, according to Monistic teaching men are but bubbles on the surface of reality, and are inevitably carried as it wills,—there is an end of all distinction between good and evil, right and wrong, merit and guilt. One man, or one line of conduct, is as good, or as bad, as another, being all equally

[1] *Confession of Faith of a Man of Science*, p. 19.

the products of Evolution, and aspects of the great Monistic principle;—"Jack the Ripper," and Socrates, Messalina and Queen Victoria, Chief Justice Scroggs and Sir Thomas More, are none of them in any possible sense one whit better or worse than the others,—inasmuch as they all did but act as puppets actuated by one and the same original, playing its own part in them all.

And in like manner as regards Truth. It must follow that a man's beliefs, like his actions, are as much beyond his own control as his stature or the colour of his hair. If Professor Haeckel calls Monism supreme wisdom, and I call it nonsense, we are equally right, for each is the mouthpiece of the same one all-embracing first-principle. What each believes is the only thing possible for him to believe, and, so far as he is concerned, is the only truth.

But here comes in a perplexity. If such be the case, if there be no Free-will, and no possibility whatever of doing or believing anything but what is predetermined for us as a necessary part of our being,—where is the sense of all the strenuous efforts that are being made to convert the people to a belief which, according to its own principles, nothing in the world can make them accept, unless nothing in the world can prevent them from accepting it? What again is the meaning of organizations, such as we hear of, for giving ethical instruction to the young on a Monistic and determinist basis? What can be the possible sense of giving ethical lectures

to young people, if it is really believed that the course of each is marked out for him more rigorously than the path of a city omnibus? "If" said Professor Paul Darnley in Mr. Mallock's clever satire,—"If we would be solemn, and high, and happy, and heroic, and saintly, we have but to strive and struggle to do what we cannot for an instant avoid doing,"—namely, conform to the laws of matter. If Monists were to limit their aspirations to this, their teaching would at least be intelligible. It ceases to be so, when they feel compelled to graft on their Monistic stock the Dualistic notions of Right and Wrong, Truth and Error. But, as Dr. Johnson said respecting Free-will, no one ever believes the arguments on the other side, however loudly he may profess to do so. And in the same way it is quite clear that no Monist can get himself really to accept Monism.[1]

[1] To what extremes such doctrines must logically lead is illustrated by Mr. Edmund Selous in his very interesting *Bird Watching*, where he casually observes, as a matter of course, that the "life-part" of a tom-tit is as important in the sum of things as Napoleon's (p. 248), and declares elsewhere, more formally (p. 335)—"Surely, a beautiful butterfly, that, for all time, charms—and raises by charming—some number of those who see it, does more good on this earth than any single man or woman, who, 'departing,' leaves no 'foot-prints on the sands of time.' Homer, for instance, has left his *Iliad* and *Odyssey*, and these have been, and still are, mighty in their effects. But let them once perish, and Homer will be caught up and overtaken by almost any bird or butterfly—even a brown one."

XIV

ORGANIC EVOLUTION

We have now considered the question of Evolution in the larger and more fundamental signification of the term to which, as we noted at starting, very different meanings are attached; and at this stage of our discussion it will be convenient to sum up the main conclusions at which we have arrived.

It is, in the first place, unwarrantable to pretend that the discoveries of modern Science, brilliant and marvellous as they undoubtedly are, have thrown any light upon the origin of the Material Universe, or of its forces, or of the laws according to which its operations proceed. Nor has Science anything to tell as to the origin of life, of sensation, or of reason. Nothing as yet discovered by her, or which she can discern any prospect of discovering, adds aught to our knowledge regarding such points as these.

Therefore, to say that the doctrine of Evolution as affirmed by Science, explains the existence of the world we know, is untrue and unscientific.

Moreover, we have seen that, as a factor without which the Order of Nature is unintelligible, the First

Cause to which her existence is owing must be possessed of Intelligence, determining her processes according to its purposes. Hence it follows that no system of philosophy satisfies our reason which would find the ultimate explanation of all things in the forces of matter themselves which it is the province of Science to investigate.

On the other hand, in maintaining that Purpose must needs have acted, we do not assume to pronounce as to the manner of its action. To say that Purpose rules every detail in the making or development of the universe, does not by any means signify that it interferes at every step with the laws of Nature. Rather, these laws are the expression of Purpose,—its machinery to secure its designed result. Assuming, for instance, the primeval existence of Professor Huxley's cosmic nebula, so constituted that the actual world was bound naturally to issue from it, as does a chicken from an egg, or an oak from an acorn,—while we find it inconceivable that such a piece of mechanism should originate without an intelligence to design it,—we have no difficulty in supposing that intelligence to have exhibited itself once for all at the first beginning, and to have fashioned the actual world by shaping the causes or conditions by which it was to be produced, thus making everything, not directly and immediately but as St. Augustine held "*causaliter et seminaliter.*"

There remains for consideration Evolution in its

narrower sense, in which its operations are restricted to organic nature, such Evolution being commonly, but incorrectly, identified with "Darwinism." Understood thus, "Evolution" signifies no more than that the various species of animals and plants have descended *genetically* one from another, through a graduated series of intermediate forms which link them together. *Darwinism* is one particular mode of explaining how such transformations may be accounted for,—namely, by what is known as "Natural Selection." The theory of Evolution, as thus concerned with Organic life in particular, is compendiously described as "Transformism," under which head Darwinism is evidently included.

Transformism makes no pretence to account for the origin of life, whether animal or vegetable. Living things must exist before any question arises as to their transmutation. But, given the existence of life, Transformists undertake in the first place to show that Organic Evolution has, as a matter of fact, occurred, and is still in process of occurrence; and secondly, to exhibit the manner in which this process is actually worked out. As to the first point, all Transformists, whether Darwinians or others, are necessarily at one, for the fact of Evolution is equally essential for every explanation of its method. It is when they come to explain in what manner evolutionary transformations have been wrought that Transformists divide themselves into various schools, each of which relies upon some particular factor to furnish the required explanation.

Thus besides Darwinians pure and simple, there are neo-Darwinians, Lamarckians, neo-Lamarckians, Weismannists, and others, ascribing the results to physiological selection, sexual-selection, or other forces, rather than natural selection. Of such systems, however, excepting only Darwinism, it will be unnecessary to speak in particular. The great fundamental question is whether genetic Evolution be really established as a fact,—which, as has been said, equally affects them all—and if it be advisable to treat more in detail of Darwinism, it is not because this does not hold good of it as of the rest—but because this particular system has obtained such a position, is so much in the mouths of men, and has been made the basis of so many and such far-reaching consequences, that it is impossible to pass it by.

Much the same may indeed be said even of the assumed fact of Organic Evolution underlying all Transformist theories. This does not affect the fundamental problems with which we are concerned, and leaving untouched, as it does, the question of the origin of Life it makes even less pretence than the cosmic-nebular hypothesis just spoken of to trace the operations of Nature to their ultimate source. It might therefore appear superfluous to devote to it so much attention as, if treated at all, it must needs demand.

But, whatever may thus appear from the point of view of strict logic, it is abundantly evident that in common estimation the assumed fact of Organic transformation is the foundation-stone of Evolu-

tionary systems of every kind. And not unnaturally; for here at last we have something with which Science can deal, strictly according to her own methods. If she knows, and can know, nothing from actual observation concerning the first beginnings of matter, of the cosmic nebula, or of life, it is quite otherwise with the history of living things since they first appeared, and with the phenomena of life as it exists and is propagated. Here are questions which are strictly scientific, forming the subject-matter of Palæontology and Biology, and these Sciences supplemented by others, such as Geology, Physical Geography, and Astronomy, furnish a mass of evidence bearing upon the subject of Organic Evolution. When therefore the great majority of men of Science, declare that the fact of genetic Transformism is established beyond the possibility of doubt, Evolutionists find themselves supplied with a plausible foothold on which to stand and rest their fulcrum, while, like Archimedes, they proceed to move the world.

That men of Science generally thus agree, cannot be questioned, and although this agreement is by no means so universal as is popularly supposed, there is no doubt that were the question to be settled by enumeration of the authorities on either side, Transformism would win easily. It may also be freely acknowledged, that Transformism in general and Darwinism in particular are theories to which on *à priori* grounds no exception need be taken, and that, so far at least as concerns their general scope,

apart from the origin of Man, no one can reasonably start with a prepossession against them. Nay, we will go farther, and say that to our way of thinking it appears immensely more probable, that things should always have gone on as they go on now, by the operation of the same natural laws, and that specific forms should have been naturally produced, as individuals of a species are produced now, by generation,—rather than that not only repeated acts of specific creation, but any operations totally different from those we witness, should have occurred to interrupt, and as we should judge, to mar, the Law of Continuity.

All this is true. But we are engaged on a scientific enquiry,—and if there be one principle more than another upon which Science insists, it is that we should prove all things, not by authority, but by evidence,—and that we should seek evidence, not in pre-conceived ideas as to what should be, but in observation of what is. Accordingly, while we are most ready to accept Transformism or Darwinism should we find solid reasons for doing so, we are bound, for the sake of Science, to demand unimpeachable proofs before subscribing to doctrines which are made responsible for so much.

Before proceeding farther it will be necessary to exhibit more in detail the exact character of the question we have to discuss.

According to the celebrated "Formula" of Mr. Herbert Spencer—" Evolution is an integration

of matter and concomitant dissipation of motion; during which the matter passes from a relatively indefinite, incoherent homogeneity, to a relatively definite, coherent heterogeneity; and during which the contained motion undergoes a parallel transformation." It would be interesting to know what idea this definition conveys to many of those who are in the habit of quoting it, but, so far as organic Evolution is concerned, it must mean that whereas in the earlier and lower forms of life one organ performed many different functions in an imperfect manner, evolutionary development has gradually produced higher forms, in which each function has its special organ, by which it is more perfectly discharged. As an extreme instance of the former condition, the Hydra has but two organs, an outside which respires, and an inside which digests. If it be turned inside out these functions are reversed; the skin becoming the stomach, and the stomach the skin. Thus Evolution has been an ascending process from the lower to the higher, from the less to the more organized.

Such, it must be added, has undoubtedly been the course of life. Amongst plants and animals alike, it began with lower and simpler forms, after which succeeded in due order others more developed and elaborately organized, the order in which they came upon the scene being much the same as that in which we should naturally arrange their specimens in a museum. Thus in the vegetable kingdom, first came such growths as sea-weeds and fungi, followed

by ferns and club-mosses,—yews and pines,—and so through grasses, canes, and palms, to the highest group in which are included our forest trees and the bulk of our garden flowers. In like manner, the animal series,—to mention only leading groups of which evidence is found,—starting with almost structureless *Protozoa*, followed by such forms as starfish and sponges, worms, molluscs and crustaceans, has advanced to vertebrate creatures—fishes, amphibians, reptiles, birds, mammals,—and finally to man.

Thus, in a quite intelligible sense, there has certainly been Evolution, or development,—that is to say, an orderly progression from lower types to higher, throughout the history of life on earth, from its commencement to the present time. But, this is not the point. Was such Evolution or development *genetic?* Was it wrought by descent with modification of form from form? *That* is what we have to enquire. If this has not been so, there has been no Evolution in the sense intended by Evolutionists.

According to their highest authority, Mr. Herbert Spencer, Evolution means "the production of all organic forms by the accumulation of modifications and of divergences by the addition of differences to differences."

Beyond all question [he adds] unlikenesses of structure gradually arise among the members of successive generations. We find that there is going on a

modifying process of the kind alleged as the source of specific differences, a process which, though slow, does, in time, produce changes—a process which to all appearance would produce in millions of years any amount of changes.[1]

The Transformist doctrine is, therefore, that one species of plants or animals, has in natural course grown out of another, through the aggregation of changes each exceedingly minute. Darwinism adds that the ruling principle of this process is Natural Selection. These are the points on which our enquiry turns, and we may conveniently commence with the second.

[1] *First Principles.*

XV

DARWINISM

It must first be observed that special consideration of Mr. Darwin's theory is rendered necessary even more imperatively on account of the claims advanced on his behalf by others, than of those to which he himself made any pretence. Without question the idea prevails almost universally, that he has furnished a scientific explanation of all organic phenomena through the operation of purely natural laws, and has thus rendered obsolete the idea that any power beyond Nature is required in order to account for the totality of things, or that there are any features of the world which indicate the operation of intelligent purpose.

That such ideas should be widely prevalent amongst those who, having no special acquaintance with the subject, must depend for their knowledge on the popularizers of Science, is scarcely wonderful, for such teachers, with scarcely an exception, so declare, and occasionally real men of Science lend the weight of their authority to similar statements.

It will be sufficient to cite Professor Haeckel, who writes thus :[1]

It seemed to Kant so impossible to explain the orderly processes in the living organism without postulating super-natural final causes (that is, a purposive creative force) that he said, "It is quite certain that we cannot even satisfactorily understand, much less elucidate, the nature of an organism and its internal faculty on purely mechanical natural principles—it is so certain, indeed, that we may confidently say: It is absurd for a man even to conceive the idea that some day a Newton will arise who can explain the origin of a single blade of grass by natural laws uncontrolled by design. Such a hope is entirely forbidden us." Seventy years afterwards this impossible Newton of the organic world appeared in the person of Charles Darwin, and achieved the great task that Kant had deemed impracticable.

It is quite impossible to understand how such an assertion can be made by any one who knows the facts. Not only did Mr. Darwin never profess to have achieved any thing of the kind,—he repeatedly and distinctly disclaimed and repudiated any such supposition. Thus at the very end of his life (August 28, 1881) he wrote concerning one who had spoken of him like Professor Haeckel:

He implies that my views explain the universe; but it is a most monstrous exaggeration. The more one

[1] *Riddle of the Universe*, p. 92.

thinks, the more one feels the hopeless immensity of man's ignorance. If we consider the whole universe, the mind refuses to look at it as the outcome of chance.[1] The whole question seems to me insoluble.

But it should not be necessary to appeal to such disclaimers in order to show how absolutely unwarrantable are the pretensions made on Mr. Darwin's behalf to have solved, or to have attempted to solve, the fundamental problems which scientific research unceasingly suggests but has never been able to elucidate. It should be quite sufficient to examine his theory as it actually is, and although its scope is immensely less ambitious than has been represented, it still occupies, even in its genuine form, a position of sufficient importance to challenge investigation.

Mr. Darwin's famous and epoch-making book, published in November, 1859, was entitled *On the Origin of Species by means of Natural Selection*,

[1] As to the term "Chance" which he frequently used, Mr. Darwin wrote in one place (*Origin of Species*, Opening passage of c. v.): "I have hitherto sometimes spoken as if the variations—so common and multiform with organic beings under domestication, and in a lesser degree with those in a state of nature—had been due to chance. This, of course, is a wholly incorrect expression, but it serves to acknowledge plainly our ignorance of the cause of each particular variation." It is obvious, however, that this explanation only serves to show that, as we have heard him confess, Mr. Darwin was anything but a clear thinker, for it is absolutely meaningless if applied to his mention of "Chance" quoted in the text above. He could not possibly mean that the mind refuses to regard the world as the outcome of a cause whereof we know nothing, for that is just what he thinks it is. Mr. Darwin, in fact, instinctively recognized, as every man of common-sense must do, that if not due to purpose, the order of Nature is due to chance, according to the true and legitimate use of the word, and thus he commonly employed it. Occasionally however he endeavoured, following Huxley and others, to defend himself against the reproach of relying upon such a factor.—*Vid. sup.*, c. xii.

or the Preservation of Favoured Races in the Struggle for Life. In it he undertook to show how from one species[1] of animals or plants, another, quite distinct from it, may be derived by means of processes which go on in Nature every day, through the accumulation of minute differences occurring in successive generations, and guided to their collective result by the force of "Natural Selection." As man, he argues, has by means of selection been able to produce in a brief space such astonishing varieties among his domestic animals and plants—as dogs, pigeons, roses or apples,—Nature, with the practically unlimited ages of geological time at her disposal, must be able to produce far greater and more enduring transformations, through the accumulation of minute differences, such as those upon which man has worked,—if only a factor can be found which amid the infinity of diverse and discordant variations spontaneously occurring, could, like the breeder or the gardener, pick out those leading to one particular result, and thus secure its accomplishment. Such a force Mr. Darwin conceives is found in "Natural Selection," which he thus explains.

[1] Although at first Mr. Darwin appeared to restrict his system to *species*, very soon, as was but natural, it was extended to the production of new *genera*, and even of divisions of the organic kingdoms yet wider asunder. Thus—apart from the most famous instance of all, treated by Darwin himself in his *Descent of Man*—it is now a cardinal point with Evolutionists generally that all the higher forms of life are descended from the lowest, and that even far up the line of development, creatures apparently the most diverse have sprung from one identical ancestor. Thus amongst vertebrates it is considered certain that Birds and Reptiles are branches of the same stock,—and, still farther on, that at least all placental mammals—bats and whales, elephants and mice—trace their pedigree to some common progenitor.

The tendency of organic life, whether vegetable or animal, being to propagate itself enormously,—and the life-sustaining capacity of the earth being limited,—it necessarily follows that only a fraction of the creatures which are born can survive to maturity, and that while those best fitted to live will live, those less well fitted will die. Thus, there is set up a constant struggle for existence, in which every advantage, however slight, must tell, so that those possessing such advantages in one generation will be the parents of the next. But in the course of propagation, the offspring never exactly reproduce the parent form, from which they vary, some in one way some in another, and as some of these variations cannot help being advantageous to their possessors in the struggle, we have here the required factor for the production of new forms. Any thus beneficially equipped, (although the variation, and consequently the advantage, must in each instance be exceedingly slight,) will have the chances on their side against their less favoured fellows, whom in the long run they will supplant. And as their offspring, or some of them, will carry the profitable variation somewhat further, the stream of life will thus be set in such a direction as will ultimately bring about what might at first appear impossible metamorphoses.

Thus, to take a simple and favourite illustration,[1]

[1] *Origin of Species*, v.

winged insects inhabiting an island far from other land, are liable to be blown out to sea and drowned. It is in consequence, an advantage to them to have their power of flight curtailed, or taken away, and consequently in such situations their wings are generally found to be so reduced as to permit little or even nothing in the way of flying. Or to take an example of another kind,[1] the extraordinary length of neck which characterizes the giraffe enables it to browse on the higher branches of trees inaccessible to other vegetable feeders, and thus gives it an advantage over them in times of drought and scarcity of fodder. It can accordingly be easily understood, how its present structure has resulted from gradual elongations of the neck, each conferring on its possessor a slight advantage.

The work attributed to Natural Selection in such instances, though no doubt highly important, is comparatively facile, and it would be difficult to say that it could not be accomplished. But Mr. Darwin ascribes to the same factor, not merely such modification of existing structures, but the creation of entirely new mechanisms for specific purposes. We have, for instance, heard his description of the eye and its manifold "inimitable contrivances:" yet all these, he persuaded himself, might be thus accounted for. The idea, he confessed,[2] seems at first sight preposterous; yet, though not without much difficulty,[3] he succeeded in convincing himself,

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[1] *Ibid.*, c. vii. [2] *Ibid.*, c. vi.

[3] "I remember well the time when the thought of the eye made

that given the rudest and most rudimentary form of eye to start with—no more than a nerve sensitive to light but incapable of forming an image—Natural Selection might develop therefrom, through an infinite series of gradations the inconceivably complex machine that is now found in the higher vertebrates,[1] and the totally different but equally marvellous organs of sight possessed by insects, crustaceans, and other creatures.

In like manner, Mr. Darwin contended, might the most complex and wonderful instincts be

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me cold all over, but I have got over this stage of the complaint, and now some small trifling particulars of structure often make me feel very uncomfortable. The sight of a feather in a peacock's tail, whenever I gaze at it, makes me sick." (*C. Darwin to Asa Gray, April* 3, 1860.)

[1] It will help to understand the nature of the task thus imposed upon Natural Selection, to consider what Lord Grimthorpe writes on this subject (*Origin of the Laws of Nature*, p. 103):

"We take pieces of glass of different kinds and grind them to particular shapes and set them in a frame and make a telescope, which refracts rays of light so as to produce an 'image' of a very distant object near our eye, and that appears much larger when seen through another glass of proper shape. But we have never yet been able to make one that can bring all the rays from a single distant point exactly to another point without confusion. Yet there are many millions of apparently self-made machines in the world that do it perfectly; and when we cut up one of them and examine it we find that instead of our large lumps of glass melted together into a coarse kind of uniformity, this machine has been built up of an innumerable quantity of particles arranged in peculiar and complicated ways, some of which have objects that we can understand, though we cannot imitate them, and others that we do not. Moreover they are persistently alike in every machine of the same class, and again some of them persistently unlike those belonging to any other class of animals. For a long time the retina of the eye used to be called a membrane, or a kind of thin sheet. Then it was found to be a kind of brush of which the hairs vibrate under the vibration of the rays of light; and now these hairs are found by further magnification to be divided into so many parts lengthwise that a picture of them has to be as long as the picture of a striped or spotted animal to distinguish them; and instead of being simply set fast by one end like hairs in a brush, they pass through several frames or membranes; and of the use of all these pieces we know nothing. Such is the 'simplicity of nature' in that organ which next to a stomach is the commonest in all living creatures; and such is our ignorance of nature yet."

generated. As an example may be cited that by which the hive-bee constructs its combs—of which he thus speaks:[1]

He must be a dull man who can examine the exquisite structure of a comb, so beautifully adapted to its end, without enthusiastic admiration. We hear from mathematicians that bees have practically solved a recondite problem, and have made their cells of the proper shape to hold the greatest possible amount of honey, with the least possible consumption of precious wax in their construction. It has been remarked that a skilful workman with fitting tools and measures, would find it very difficult to make cells of wax of the true form, though this is perfectly effected by a crowd of bees working in a dark hive.[2] Granting whatever instincts you please, it seems at first sight quite inconceivable how they can make all the necessary angles and planes, or even perceive when they are correctly made. But the difficulty is not nearly so great as it at first appears: all this beautiful work can be shown, I think, to follow from a few simple instincts.

He accordingly proceeds to argue, that beginning with circular cells, like those of Humble Bees, and progressing through an intermediate form, circular where free, but with flat partition walls where two

[1] *Ibid.*, c. vii.

[2] Although, as bee-keepers soon discover, Mr. Darwin supposed the workmanship of bees' cells to be considerably more exact and accurate than usually is the case,—there remains quite enough of architectural merit to justify his remarks. It may even be said to increase the mystery that the insects should thus appear to strive towards an ideal, which they frequently fail to satisfy.

or more cells touch one another, it is quite possible to suppose that Natural Selection has effected the whole improvement, those insects which accomplished any advance towards more scientific workmanship, and thus made materials go further, having been able to secure a livelihood better than their competitors.

Such in brief outline is the Darwinian system, which undertakes to account for all the alleged facts of Organic Evolution by means of the above factor, variously described as "Natural Selection," or the "Survival of the fittest in the Struggle for Existence." It should be remembered, though it is constantly forgotten, that it is this particular theory as to the working-cause of evolutionary transformations which is the essence of Darwinism. Mr. Darwin did not originate the idea of genetic transformism, which is almost necessarily suggested by the systematic development of life-forms to which Geology bears witness. Consequently, long before he came on the scene, the doctrine of transformation had been propounded, especially by Lamarck, and if it had met with no general acceptance, this was chiefly because no force was indicated which seemed to offer a satisfactory account of the mode in which the required changes could have been wrought. Such a force Mr. Darwin's "Natural Selection" was widely taken to furnish, and his theory was eagerly welcomed and adopted by those who only required such a basis on which to ground beliefs to which they were already predisposed, and Darwinism thus obtained that

pre-eminent position which it still retains, at least in popular estimation.

Two special arguments may here be mentioned, which, although they really apply to all systems of Organic Evolution, have obtained a prescriptive right to be quoted particularly in favour of Darwinism, their bearing on which is easily seen.

The first is based on the frequent occurrence of "rudimentary," "fragmentary," or "vestigial" structures in animals and plants, which, although now seemingly useless, or even harmful, to their possessors, may be assumed to have been of service to their ancestors, but under changed conditions to have been thrown out of work by Natural Selection, and atrophied by disuse. Such are—the splint-bones of the horse, representing lost digits,—the rudimentary legs of some whales and serpents,—the *mammae* and mammary glands of male mammals; and in the vegetable kingdom,—the aborted pistil in male florets of some *compositae*,—the useless corolla of certain wind-fertilized flowers, as *plantago*, and indeed the whole floral apparatus of plants which, like Wordsworth's pet the Lesser Celandine,[1] seldom ripen their seeds, but depend on other methods of propagation. The other fact cited on behalf of Darwinism is unquestionably very striking. In the course of their embryonic development, and even in the initial stages of their life after birth, higher animals pass through various phases in which they

[1] *Ranunculus ficaria.* It is remarkable that in the season of 1904 this plant has ripened fruit profusely in various districts in which such fruit had for many years been practically undiscoverable.

exhibit the characteristics of lower forms. Thus all life starts from a cell, in which there is nothing to shew whether it is ever to be anything more than a cell, or is to evolve a plant or animal,—nor, in this latter case, what sort of animal it is to be—a mollusc, for instance, a frog, or a mammal. At a later stage[1] it is impossible to distinguish the embryos of lizards, birds, and mammals except by size. Even the human fetus at an early period bears vestiges of gill-clefts or arches, pointing to an aquatic existence. When the extremities come to be developed,[2] "The feet of lizards and mammals, the wings and feet of birds, no less than the hands and feet of man, all arise from the same fundamental form." The young of flat-fish such as soles and turbots, when they leave the egg are not flat, but shaped like ordinary fish, and they wear their eyes in the normal fashion, one on each side of their head, not both on the same side like their parents—whose form however they presently by degrees assume. Young lions and blackbirds are spotted, showing their affinity respectively to panthers and thrushes—and so on in numberless instances. All such features, it is assumed, indicate the *phylogeny* of each animal, or the history of the race to which it belongs. As Professor Milnes Marshall succinctly put the matter: [3]

[1] *Origin of Species*, c. xiv.

[2] *Descent of Man*, Part 1, c. i.

[3] *Biological Lectures and Addresses*, p. 202.

> The phases through which an animal passes in its progress from the egg to the adult are no accidental freaks, no mere matters of developmental convenience, but represent more or less closely . . . the successive ancestral stages through which the present condition has been acquired. Evolution tells us that each animal has had a pedigree in the past. Embryology reveals to us this ancestry, because every animal in its own development repeats this history, climbs up its own genealogical tree.

Such are not by any means the only instances in which the Darwinist can appeal to Nature for facts with which his theory well agrees, and which therefore so far furnish a persuasive argument in its favour; but these are perhaps the chief ones, and the best known, and may serve as representative of their class which it is impossible for us to examine in detail.

It now remains to enquire how far, from the point of view of Science, with which alone we are concerned, the Darwinian hypothesis can make good its claim to our acceptance. When we proceed accordingly to examine the grounds upon which it rests, it must be confessed that as we do so it becomes increasingly difficult to understand how such a theory has been able to obtain such wide acceptance, especially on the ground that scientific evidence is in its favour.

On the very threshold of any such enquiry lies a difficulty the gravity of which seems to be strangely

overlooked. Darwinism by its own confession knows nothing of Origins, not even of the Origin of Species itself. There must be life already existing before Natural Selection has anything to select; there must be eyes and honey-cells of some kind, before they can be improved; there must be Species, before one can be transformed into another. Is it not evident, however, that the cause—of whatever kind it may be—which brought any of these into being, must have *something*,—not to say everything,—to do with the capacities and potentialities by which its future history is conditioned? But this supreme and vital factor Mr. Darwin entirely eliminates from his calculation. In his system, the initiating force has no more to do with the subsequent career of its productions, than has the gas which lifts a balloon with the direction in which it travels. It is not, on his theory, as the impulse which, besides raising from earth an arrow or rifle bullet, directs it to a goal, but, on the contrary, an organism once launched on its course is left to be driven hither and thither and twisted into this form and that, as clouds are by the wind. For the variations through which transformations are wrought, Darwin could find no better epithet than "fortuitous," and it is laid down by his staunchest disciples that if such variations be predetermined towards certain results, there is an end of Darwinism.

It is not easy to understand how any theory can be deemed satisfactory which thus ignores the initial force, of whose existence and potency we have far clearer evidence than of any other.

When we turn from its omissions to study Darwinism as it is, obviously, in the first place, still, more than forty years since it was given to the world, it remains only an hypothesis, based not upon observation or experiment but speculation. In no single instance, past or contemporary, is one species known to have originated from another. The fact upon which Mr. Darwin primarily relies is that of variation. Undoubtedly amongst both plants and animals the offspring are not mere slavish reproductions of their parents, as if cast in the same mould, but exhibit individual differences, working upon which in domesticated instances, man can by selection produce wonderful varieties, as has already been admitted. But, as M. de Quatrefages says,[1] this tells us no more than that species admit of variation; it does not prove that they are capable of transformation, which is the whole point. Certainly, such transformation has never within our knowledge been effected. No breeder or fancier has succeeded, or can hope to succeed, in producing a new species. Moreover, as was pointed out by a critic whose ability Mr. Darwin himself candidly acknowledged,[2] the range of variability as we find it in any species is strictly limited, and although at first it is easy,—in the case of some few animals or plants,—to make great changes in particular directions, by selective breeding, it becomes more and more difficult

[1] *Charles Darwin et ses précurseurs Français* (1870), p. 120.

[2] *North British Review*, June, 1867. Professor Huxley likewise declared this criticism to be of "real and permanent value." (*Critiques and Addresses*, 252.)

as we proceed to continue in the same line. If, for instance, in the case of pigeons, a bird can be produced in six years with head and beak only one-half the size of those whence the process started, are we to say that in twelve years their bulk will be reduced to a quarter, and in twenty-four to an eighth? No one could suppose anything so absurd. Mr. Darwin would answer, that he relies upon the vast periods of geologic time to produce alterations such as we cannot possibly attempt within the few years at our disposal. But, it is replied, no length of time will avail anything for such a purpose, unless there be some force to produce variations in the required direction, to the required extent. Such a force is not proved to exist—all the evidence is against it. Where art is most practised in improvement of breeds, or the obtaining of any peculiarities—as with the speed of racehorses, the size of toy-terriers, or the "points" of prize cattle, it becomes most strikingly apparent that we have reached a limit beyond which species will not vary. And until such a cause as we require is fully proved to exist, its supposed effects cannot be made the basis of scientific argument.

A given animal or plant, [says the Reviewer] appears to be contained, as it were, within a sphere of variation; one individual lies near one portion of the surface, another individual near another part of the surface; the average animal at the centre. Any individual may produce descendants varying in any direction, but is more likely to produce descendants varying towards the

centre of the sphere, and the variations in that direction will be greater in amount than the variations towards the surface. Thus a set of racers of equal merit indiscriminately breeding will produce more colts and foals of inferior than of superior breed, and the falling off of the degenerate will be greater than the improvement of the select (p. 282).

Similarly M. Blanchard declares: [1]

All investigation and observation make it clear that, while the variability of creatures in a state of nature displays itself in very different degrees, yet in its most astonishing manifestations it remains confined within a circle beyond which it cannot pass.

And the facts of nature, as we know them, far from favouring the instability of species, exhibit a tenacity of form compelling us to treat them as practically immutable. Thus, as Mr. Carruthers points out,[2] in the notoriously variable genus *Salix*, or willow-tribe, which seems to be actively advancing towards a multiplication of its subdivisions, sub-genera, species, varieties, and hybrid forms, —one species is found, *S. polaris*, dating from before the Glacial Epoch, which has been driven from England and other lands, by climatic changes, to within the Arctic circle of both Hemispheres,—yet amid this stress of circumstances has preserved its specific identity, down even to the casual variations, which might be supposed to furnish the starting-points for new developments. Yet in this tribe,

[1] *La vie des êtres animés*, p. 102.

[2] Presidential Address Geologists' Association (*Proceedings*, vol. v. 1875–6). Partly reprinted in *Contemporary Review*, February, 1877, under the title "Evolution and the Vegetable Kingdom."

if anywhere, evidence of specific evolution might be looked for.

Other instances seem to show that even under new and trying conditions those creatures survive best which keep closest to the central family type, not those which diverge in any direction. Thus, of European sparrows introduced in America, Mr. Bumpus writes:[1]

> Natural Selection is most destructive of those birds which have departed most from the ideal type, and its activity raises the general standard by favouring those birds which approach the structural ideal.

Variation supplies the raw material upon which Natural Selection is supposed to work. When we turn to examine the process by which its results should be produced, we find, quite apart from the above difficulties, a crop of others still more formidable.

It must be remembered, that the variations on which Natural Selection must work are in each instance extremely minute, well-nigh infinitesimal. Mr. Darwin was as strongly opposed to the idea of Nature making sudden bounds, as to that of a predetermined course of development. But, he argued, an extra chance of living, however slight, must necessarily tell in the long run, the theory of probabilities giving results as certain as any others in mathematics, and, according to these, we may confidently say that, given sufficient time, the

[1] *Variation in Animals and Plants*, p. 343. By H. M. Verney (International Scientific Series, 88).

favoured individuals would infallibly distance their competitors.

The impressiveness of such an argument depends upon its seemingly mathematical character, which is however wholly fallacious, for the probabilities are all the other way. It is perfectly true that a beneficial variation however slight will confer on its happy possessor a corresponding advantage in the struggle for life, as compared with each *individual* of the non-favoured herd, but, as to that herd collectively, the chances would, on the contrary, ensure that *some* of its members should outlive the favoured one. Let us even imagine the advantage of the latter to be very great, great enough to double his chances, so that the odds on his surviving each of his fellows will be two to one. Yet if there be a dozen of them to contend with, the odds will be six to one *against* his surviving the lot. And what of the actual case of minutest benefits conferred by variation? In order to give them even an equal chance of survival, the numbers of those possessing such advantages must be large in proportion as the advantages themselves are small. Thus, if a variation increases the chance of life by one-thousandth part, so that the odds on its possessor are 1001, against 1000 on each non-possessor, yet unless the number of possessors be to that of non-possessors as 1,000 to 1,001, their collective chances will not even be equal. As it is quite absurd to suppose that casual variations could ever occur in such wholesale fashion, how can it

be supposed that, were Natural Selection the only factor operating, minute advantages could be accumulated by variation even in the simplest cases?

But it is also hard to suppose that in any actual case is the matter so simple as it appears to our limited comprehension. To take for instance the above example of the giraffe. It is very well to have a neck that will reach high-branches of a tree,—but this is not everything. For the mere prolongation of life, much else is required, fleet limbs to distance lions, and keen senses, sight, hearing, and smell, to give warning of the approach of human or other hunters, to say nothing of the extra strengthening of muscles and bones which increased size and weight demands. Unless, however, improvements in all these respects happened casually to concur in the same individual, which could scarcely happen, it is clear that each would militate against the others, for the survival of an individual beneficially developed in one respect, would tend to the extinction of other beneficial developments, possessed by individuals whom he overcame in the struggle for life.

Even the case of the insular insects is by no means so plain as might at first sight appear. There can be no doubt that wings are of *some* advantage, or on no system could they be supposed to exist. Nor do their advantages cease because disadvantages outweigh them. If some insects are blown out to sea when flying, others will doubtless perish in one way or another because they cannot fly. It may

even be that those which can fly *best* will survive, as being able to make head against a breeze which overpowers others. Natural Selection will thus have many arrows in its quiver, some of which must reach the wrong objects.

Still more clearly does this appear in the case of complex structures in which, if they were produced as Mr. Darwin supposes, variation must have hit simultaneously upon independent contrivances, without each of which all the others would be useless and confer no benefit at all. In the eye, for example, to mention but one or two of innumerable similar points, it would be of no avail to have a retina, even such as has been described, without a lens to throw an image upon it, set just at the proper distance, and provided with muscles to alter its shape according to the distance of the object. How can Natural Selection be even conceived to have set to work on such a task as this?

It is still more fundamental to observe that, according to Mr. Darwin's own showing, Natural Selection is purely negative in its action. "If it does select, it selects for death and not for life."[1] It can originate nothing, but only destroy. All that it does for favoured races is to spare them while it sweeps away others, and the sole benefit they derive from it is to have more ample resources upon which to draw. But as for anything they possess in the way of structure or character, they must derive it entirely from themselves—Natural Selection can no more confer it, than the labourer who weeds a garden bed makes the flowers that grow there. Let

[1] J. W. Barclay, *New Theory of Organic Evolution*, p. 90.

it be imagined that the first human beings on earth, any number of thousand years ago, planted a garden, and determined to produce a rose, by eliminating every plant that did not show some promise of progress rose-wards. Let the gardeners have been endowed with acumen sufficient to detect every symptom of such a tendency, and let their operations have been carried on without interruption to this day,—it is obvious that if roses had resulted, it could only be because among the plants they allowed to remain there existed a rose-making quality of some kind, to which, and not to anything done by human art or skill, the result was due. It would likewise have to be supposed that there were infinite other potentialities latent in the original plants, as of evolving thistles, shamrocks, or leeks—all equally awaiting their opportunity. Selective action could effectually put such competitors out of the way; but in the way of developing a race it could but leave it entirely to itself. Precisely similar is the part played by Natural Selection, except that it must needs play it immensely more slowly,—and if no one can fancy that human agency could by any possibility grow roses unless from some stock predetermined to grow into a rose and nothing else, what grounds have we that can be called scientific for attributing to a blind struggle for life an incomparably greater potency? Nor does it avail to quote the immense extent of time which may be supposed to have been available. No more than Natural Selection has

time by itself any creative power. We know on the contrary by experience, that when things are not controlled by some principle of order, the lapse of time serves only to make confusion worse confounded.

Another consideration of prime importance is too frequently ignored. On Darwinian principles, each step in any development can be made, not because it leads to an advantageous result in the future, but only because it is itself advantageous. At each stage favoured individuals survive others because they are favoured here and now, not because, when the development they promote shall be completed, their remote descendants will be favoured. Hence it must, for instance, be possible to suppose, that all the intermediate forms between two extremes, whereof one is supposed to have originated the other, were, each in its day, so beneficial as to preserve their possessors at the expense of non-possessors. But can this possibly be even imagined?

To take one example. We have heard, speaking of embryology, that the feet of lizards and the wings and feet of birds arise from the same fundamental form of limb, whence it is argued that birds and lizards are alike descended from a common sauroid, or lizard-like, ancestor, whose limbs in the case of the former class have developed into wings and into feet of a totally new type,—while scales were developing into feathers, and innumerable alterations of internal structure were simultaneously in progress. But

if so, to confine our attention to one particular, it must be true that each of the innumerable minute gradations between the fore-limb of a lizard and the wing of a bird, was in its turn the best kind of member for a creature to possess, giving him a distinct advantage in the struggle for existence. Nothing, however, appears plainer than that this could not possibly have been the case. The limb shaping towards a wing would be a very clumsy and inefficient leg long before it got to the point at which it became of the slightest use for purposes of flight, that is to say before its alteration was accompanied by any utility whatever. We can neither imagine that creatures furnished with limbs of such intermediate forms could have been otherwise than hopelessly handicapped by them, nor do we find anywhere in the rocks any trace whatever of the innumerable series of modifications which would be needed to link by imperceptible gradations legs and wings together.

It only serves to make the matter less intelligible, that there *are* found in Secondary strata some few relics of birds with decidedly saurian characteristics,[1] as the *Hesperornis* and *Ichthyornis* in the Chalk, and the *Archæopteryx*, most ancient of fowls, lower still, in the Oolite. All these creatures have lizard-like heads and teeth ; the *Archæopteryx* in addition has decidedly reptilian characters connected with its wings and tail. But none of them throw the slightest light upon the point we are now con-

[1] Huxley, *Lectures and Essays* (Popular Edition), pp. 28, seq.

sidering. In the case of all, the problem of flight has been completely solved. Their wings are no rudimentary structures half way between legs and wings, but as finished productions as those of to-day. As Professor Huxley acknowledges, if the skeletons of *Hesperornis* and *Icthyornis* had been found without their skulls, they would probably have been classed without more ado amongst existing birds. The latter "has, [he tells us,] strong wings, and no doubt possessed corresponding powers of flight." The wings of *Hesperornis*, he says, resemble those of our divers and grebes, and were probably used, like theirs, chiefly for swimming.[1] As for the *Archæopteryx*, its reptilian features notwithstanding, it is a perfectly-appointed bird. As Sir Richard Owen testifies,[2] its wing, despite the peculiarities mentioned, is completely developed as to all essentials. Nor does even this member furnish the creature with its most bird-like characteristics,—but the keeled breast-bone, so intimately connected with the requirements of flight,—and, still more markedly, the feet. Professor Huxley writes: "The feet are not only altogether bird-like, but have the special character of the feet of perching birds; while the body had a clothing of true feathers."

[1] Since Professor Huxley wrote the idea has been completely discarded that these birds occupy such a place as he assigned them. The wing of *Hesperornis*, for example, is now declared to be an instance of *degeneration* from one capable of flight. None of these fowls can be considered as the progenitors of any now existing, but all as the descendants of flying ancestors of arboreal habits, whereof no trace has yet been discovered. (See ycraft's *Story of Bird Life*, p. 190.)

[2] *Philosophical Transactions Royal Society*, 1863, p. 36.

Thus, to whatever these Saurian birds may testify, —and the extreme importance of their evidence none will question—they no more serve to bridge the gulf between reptiles and birds, than a group of volcanic islets like the Azores bridges the Atlantic, for they supply no vestige of a continuous way from one term to the other. Rather, they do but enhance the mystery of the transformation, to the manner of which, despite their composite features, they furnish no clue.

All such difficulties are enormously aggravated by a consideration which, obvious as it is, seems seldom to be considered. The arguments we commonly hear appear to imply that *one* parent is sufficient to secure the transmission of a beneficial variation to the next generation. But, of course, the parent requires a mate, and unless this mate has chanced to hit on the same line of variation, it cannot be supposed that it will be transmitted. Seeing, however, the exceeding minuteness of these variations in each instance, they can avail nothing to bring together the right mates to perpetuate them. Two reptiles, for instance, are not the more likely to pair because their fore limbs have taken the first faint and distant step towards becoming wings, while in the vegetable kingdom, notwithstanding Erasmus Darwin's *Loves of the Plants*, the idea of any choice of partners is still more grotesque. The allotment of mates must therefore be left to Chance; and the results will follow the ordinary laws of probability. Accordingly, if we suppose so large a

proportion as five per cent., or one in twenty, of any species to possess an advantageous variation,—only one in twenty of the individuals thus favoured will secure a similarly favoured mate,—for each will have nineteen wrong selections offered to him or her, for one right one. Only one pair in four hundred will therefore transmit the variation to five per cent. of *their* offspring, or one in eight thousand of the species, and of these only one pair in a-hundred-and-sixty-thousand will make an advantageous match. Such is the inevitable consequence of leaving any definite result to Chance: and here it is that Natural Selection is found to betray the most fatal of all its deficiencies; for, whatever its advocates may say, it is Chance and Chance alone upon which it relies. Just because man can and does select the proper mates, is he able to produce by breeding the results to which Mr. Darwin appeals as evidence, that Nature having no such power of selection, must be able to produce results of which man cannot even dream.[1]

Natural Selection is in truth no selection at all, that is just its weak point, which the title conferred upon it serves to hide. What are called its products owe no more to it than Wellington owed his generalship to the bullets which did not hit him at Seringapatam. If they are not determined to a particular development they can attain it only by Chance.

Of Chance, enough has already been said. It is,

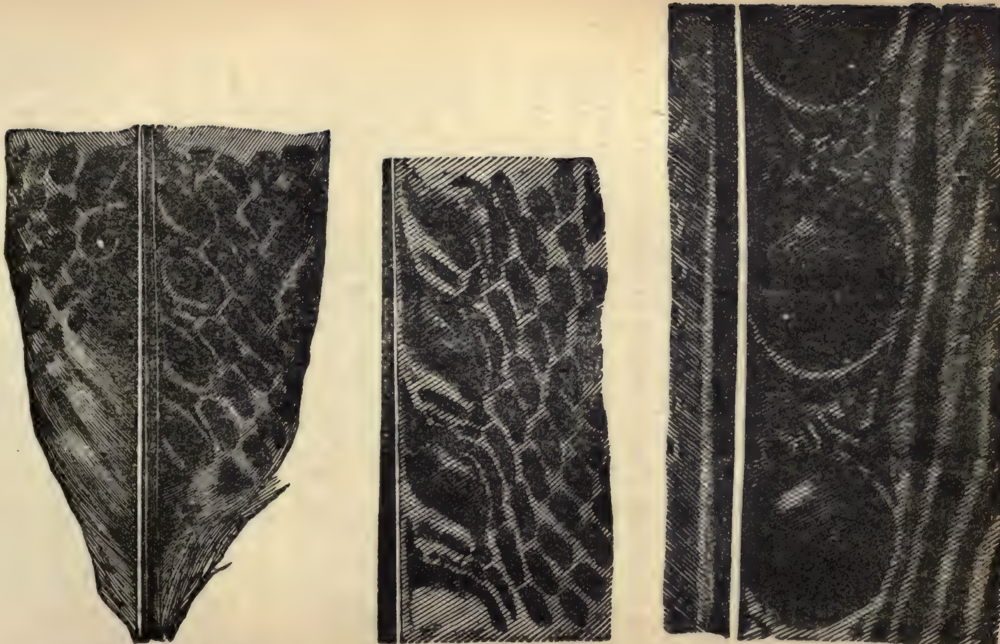
[1] This point is well handled by M. Paul Janet, *Final Causes*, 2nd English Edition, p. 245.

however, worth our while to observe how constantly to the last Mr. Darwin was haunted by the consciousness that this was in reality the factor upon which his system must depend, and that it could not possibly account for much that he came across in nature. If, as he confessed, the sight of a peacock's tail-feather made him sick, it was just because its elaborate beauty, to which no commensurate advantage can be supposed to attach, forbade the notion that his theory could account for it. So, of another still more marvellous instance in which Nature exhibits artistic power, namely the ball-and-socket ornament on the wings of the Argus pheasant, he writes :[1]

No one, I presume, will attribute this shading, which has excited the admiration of many experienced artists, to chance—to the fortuitous concourse of atoms of colouring matter. That these ornaments should have been formed through the selection of many successive variations, not one of which was originally intended to produce the ball-and-socket effect, seems as incredible as that one of Raphael's Madonnas should have been formed by the selection of chance daubs of paints made by a long succession of young artists, not one of whom intended at first to draw the human figure.

Nevertheless, Mr. Darwin proceeds to argue at considerable length that an explanation consistent with his theory is favoured by the occurrence on the same wings of designs exhibiting every stage

[1] *Descent of Man*, ii. 156.



1\. Basal portion of secondary wing-feather; nearest body, shewing first rudiment of "ocelli."

2\. Portion of secondary wing-feather near body, shewing "elliptic" ornaments.

3\. Part of secondary wing-feather, shewing developed "ocelli."

Feathers from wing of Argus Pheasant, from Darwin's *Descent of Man.*

of gradation from a mere spot to the finished ball-and-socket *ocellus;* in the same way as the tail feathers of a peacock advance from a mere sketch to the completed design. It is not easy, however, to understand in what way this is supposed to solve the difficulty and not vastly to increase it. That a finished artistic effect should be fortuitously produced at all would be incredible enough. That it should be worked up by Chance through a series of processes, each doing something towards its completion, is surely not less, but far more inconceivable.

In such a mode of explanation, however, is exemplified a feature which must not be forgotten in discussing Darwinism,—namely the fatal facility with which seeming arguments can be procured on its behalf. As Mr. Mivart well remarks:[1] "The Darwinian theory has the great advantage of only needing for its support the suggestion of some possible utility, actual or ancestral, in each case—no difficult task for an ingenious, patient, and accomplished thinker." And our *North British* Reviewer makes a similar comment: "The believer who is at liberty to invent any imaginary circumstances, will very generally be able to conceive some series of transmutations answering his wants."

Or if, as in the above instance of the Argus' eyes, a series is actually found, it is even less difficult to take for granted that it can have but one significance; while such assumptions are too frequently

[1] *Tablet*, May 26, 1888, p. 837.

accepted without hesitation or demur, although it would be no easy task to show that they rest upon any solid grounds. When, in addition, either Mr. Darwin himself or some of his leading partisans has declared that some unverified process has undoubtedly occurred, or that they see no reason to doubt its occurrence, or that nothing which we know precludes its possibility,—it appears to be widely supposed that something substantial is thereby added to the scientific evidence, and that the suppositions thus sanctioned may even rank as facts. But however such a method may avail to secure acceptance for a doctrine, it does nothing for its scientific value. Such a style, as Mr. Mivart says,[1] is calculated to impress only minds too easily dominated, and not prepared by special studies accurately to weigh the evidence put before them.

Illustrations of this strange method of procedure are furnished in connexion with various points already mentioned. Thus, as we have seen, Mr. Darwin attempts to explain the origin of rational speech, by the conscious utterance of a significant sound by an unusually wise ape-like creature. In favour of this very large suggestion, Mr. Darwin has nothing more substantial to say[2] than that "it does not appear altogether incredible," which does not appear to take us very far.[3] Yet I have

[1] *Lessons from Nature*, p. 297.

[2] *Descent of Man*, i. p. 57.

[3] In later editions (e.g. that of 1888, i. 133) the suggestion is put in form of a question : " May not some unusually wise ape-like animal . . . ? "

seen this described as an "idyllic scene" shedding an entirely new light on the subject. So again in regard of the evolution of the eye.[1] Having summarily enumerated the various stages of development exhibited by this organ as actually existing in various animals, Mr. Darwin goes on to say that when we remember how small the number of living forms must be in comparison with extinct, and the other gradations that may consequently have existed, "the difficulty ceases to be very great" in believing that Natural Selection has connected the most rudimentary with the perfect structure. Similarly, as to the cell-making instinct of the bee,[2] having postulated four several suppositions for which evidence is not forthcoming, he concludes: "By such modification of instincts . . . I believe that the hive bee has acquired, through natural selection, her inimitable architectural powers."[3] Similar examples might be multiplied indefinitely.

Not unfrequently the tone of such utterances is more imperious. Thus, of the descent of Man from some animal ancestor Mr. Darwin pronounces[4] "The grounds upon which this conclusion rests will never be shaken," and again[5] "the possession of

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1 *Origin of Species*, c. vi.

2 *Ibid.*, c. viii.

3 It is a grave aggravation of the problem, which need only be mentioned here, that the bees which make cells are neuters and have no descendants, while the queens and drones which are the progenitors of the whole race never do a stroke of work in the course of their existence.

4 *Descent of Man* (1st Edition), ii. 385.

5 *Ibid.*, i. 107.

exalted mental powers is no insuperable objection to this conclusion" . . . "It is only [p. 32] our natural prejudice which leads us to demur to this conclusion." He even goes so far as to declare that his view is forced upon every man who is not content to assume the mental attitude of a savage.[1]

Argumentation of this character, which he finds common with Darwin to other Evolutionists, is judged by de Quatrefages to be one of the weakest and most misleading features of their systems.

Personal conviction [he writes],[2] mere possibility, are offered as proofs, or at least as arguments in favour of the theory. Can we admit their validity? Obviously not. The human mind can conceive many things: is that a reason for accepting them all? . . . Obviously more serious proofs are needed. After all, save where a contradiction is involved, everything is *possible*. . . . If adopting, under the shadow of Oken's great name, his principle of the repetition of phenomena, a naturalist should maintain that each of the planets has its own Europe, its England, and its Darwin expounding to the Jovians and Saturnians the origin of species, I do not quite see how one would set about showing him that he was wrong. Unquestionably the thing is *possible*. Are we to draw the conclusion that it is a fact?

Again,[3] the same distinguished naturalist, having quoted Darwin's very elaborate explanation of a difficulty, remarks:

1 *Ibid.*, ii. 386.
2 *Charles Darwin et ses précurseurs Français*, p. 151
3 *Ibid.*, p. 167.

We see how with Darwin, as with his precursors, one hypothesis necessitates another. But can he, at least, by means of these subsidiary theories, these comparisons, these metaphors, account for all the facts? No, he himself honestly confesses more than once that he cannot. It is true that he adds "I am convinced that the objections have little weight, and the difficulties are not insoluble." But is this conviction of his a proof, or even an argument?

M. Blanchard likewise comments vigorously on this mode of argumentation. Speaking of the Mole and Darwin's explanation of its blindness, namely that having taken to living under-ground it lost its eyes through disuse—which he considers a most preposterous supposition,—M Blanchard continues:[1]

The realms of fancy are boundless; but the observer who is concerned with realities can only have recourse to the facts of science. Fossil remains discovered in very ancient strata show that the underground animal of present times does not differ from his geological counterpart. The Mole belongs to a very peculiar type, and has no nearer European relatives than the Hedgehog and the Shrew. Can we imagine a common ancestor of Shrews, Hedgehogs, and Moles? On this point Mr. Darwin expresses no opinion,—which should not be, for when confronted by forms clearly differentiated, he is wont to extricate himself from difficulties with matchless facility. The intermediate links, he will say, were doubt-

1 *La vie des êtres animés*, p. 161.

less less fitted to live than were the others, and so have disappeared. After *that* the Evolutionists consider any one quite out of date who does not consider himself entirely satisfied with so felicitous an explanation.

M. de Quatrefages denounces another fatal defect often observable in the method of proof.

Mr. Darwin frequently complains that our actual knowledge is incomplete. But instead of discovering in our lack of precise and extensive information a motive for caution, he appears to derive from it only greater daring. Doctrines based on the instability of species have often been combated by geologists and palæontologists. In reply to their objections Darwin devotes a whole chapter to shewing the imperfection of the geological record. "For my part," he concludes, "I look at the geological record as a history of the world imperfectly kept and written in a changing dialect; of this history we possess the last volume alone, relating only to two or three countries. Of this volume, only here and there a short chapter has been preserved; and of each page, only here and there a few lines. Each word of the slowly-changing language, more or less different in the successive chapters, may represent the forms of life, which are entombed in our consecutive formations, and which falsely appear to have been abruptly introduced. On this view, the difficulties above discussed are greatly diminished, or even disappear."

On my part [continues M. de Quatrefages] I will ask whether such a conclusion is the correct one. No doubt, Darwin is right in refusing to certain naturalists the

right to dogmatize on the strength of uncompleted studies, or scanty and isolated observations. Is he therefore entitled to allege as proofs on his own behalf the very gaps of science, appealing to the lost volumes and leaves of Nature's chronicle? Clearly not. But the slightest reflection suffices to recognize that this appeal to the unknown, so frankly evidenced in the above passage, lies at the root of all argumentation analogous to that which I have tried to describe—that of Maillet, Lamarck, and Geoffroy,[1] as well as Darwin. Only the unknown, in sooth, can open the boundless region of speculation, where the possible replaces the actual, and where, despite the widest knowledge and the soundest intelligence, one comes as by a fatality to find a conclusive proof on one's own side, precisely in that of which we profess to know nothing.

So again, speaking of a certain conclusion of Professor Haeckel's concerning the embryology of lemurs, which MM. Grandidier and Alphonse Edwards afterwards proved experimentally to be altogether erroneous, de Quatrefages writes:[2]

Haeckel will perhaps answer that the publication of his book preceded the observation of the French savants. But such a plea itself discloses a method of procedure which is common to the majority of evolutionists, and of which, it must be added, Darwin set the example. When confronted by a question about which nobody knows anything, they appeal precisely to this want of

[1] Saint-Hilaire.
[2] *Les Émules de Darwin*, ii. p. 82.

knowledge, and draw arguments from their very ignorance.

In like manner speaks the Reviewer already cited more than once. Thus : [1]

The peculiarities of geographical distribution seem very difficult of explanation on any theory. Darwin calls in alternately winds, tides, birds, beasts, all animated nature, as the diffusers of species, and then a good many of the same agencies as impenetrable barriers. . . . With these facilities of hypothesis there seems to be no particular reason why many theories should not be true. However an animal may have been produced, it must have been produced somewhere, and it must either have spread very widely or not have spread, and Darwin can give good reasons for both results.

And again : [2]

We are asked to believe all these maybes happening on an enormous scale, in order that we may believe the final Darwinian "maybe" as to the origin of species. The general form of his argument is as follows :—"All these things may have been, therefore my theory is possible, and since my theory is a possible one, all those hypotheses which it requires are rendered probable." There is little direct evidence that any of these maybes actually *have been*.

In no respect, moreover, have Darwin's followers more closely imitated their master than in the con-

[1] *North British Review*, July, 1867, p. 316.
[2] P. 313.

struction of such hypotheses, which would appear to constitute in the eyes of many the most important work of Science. Attention has very largely been diverted from Nature as actually existing, which seems to be studied more for the light it can be supposed to throw upon evolutionary history, than simply for itself, and it seems to be thought that to imagine the mode of an evolutionary process is equivalent to establishing the facts which that process supposes. By this method lengthy and learned papers are written concerning the transformation of one species into another, which in reality do no more than describe in minute detail all the changes which must have taken place, *if* the said transformation really occurred. That Science is thus benefited, is not the opinion of some at least who are well entitled to speak on her behalf, for as the President of the Linnean Society recently observed,[1] as one grows older, it becomes more and more apparent that facts alone are of any serious interest, and that speculations however ingenious and attractive are best left to the constructive and destructive energies of the young. So too, a few years ago, the President of the Microscopical Society complained that interest in living creatures is largely supplanted by dead ones.[2]

We read much [he said] of the animal's organs : we see plates showing that its bristles have been counted,

[1] November 5, 1903, *Journal of Botany*, January, 1904, p. 32.
[2] Dr. Hudson, see *Nature*, February 20, 1890, p. 375.

and its muscular fibres traced to the last thread; we have the structure of its tissues analyzed to their very elements; we have long discussions on its title to rank with this group or that; and sometimes even disquisitions on the probable form and habits of some extremely remote, but quite hypothetical, ancestor, who is made to degrade in this way, or to advance in that, or who is credited with one organ or deprived of another, just as the ever-varying necessities of a desperate hypothesis require. . . .

There is another aspect of the question which must by no means be overlooked. It has to be assumed that Natural Selection, or the survival of the fittest in the struggle for existence, necessarily tends to the benefit of the *race* and moreover to its farther development on the upward grade, towards a more perfect and more specialized organization;—in Mr. Herbert Spencer's words, to progression from a relatively indefinite incoherent homogeneity, to a relatively definite, coherent heterogeneity. But here many questions occur.

In the first place, a consideration presents itself, which appears to furnish the most formidable of all difficulties in the way of Mr. Darwin's hypothesis. How can this struggle for existence be supposed to have any tendency to promote organic development to ever higher and more perfect types, in the orderly sequence which has in fact occurred? The "Survival of the fittest" means only the survival *of the fittest to survive*,—of such as can find means of living where others cannot. Unless it can be shown

that increased complexity of organization necessarily brings with it such increased vitality, Natural Selection can do nothing for organic development. If the mere power of living be the only factor in the process, as on Mr. Darwin's showing it is, a man is only a more complicated and delicate machine for securing the same object which can equally well, or better, be attained by a mole, a cockroach, or a microbe. And who will say that, so far as this particular end is concerned, he is better equipped than creatures which all the resources of civilization are powerless to exterminate ?

That practical advantage in the struggle for existence must necessarily accompany increased specialization of organs, and thus produce a "higher" organization, was a prime point of Mr. Darwin's argument, though at the same time he found himself compelled to encumber it with qualifications which go very far to neutralize its force ; for he had to explain the obvious fact that so many creatures which represent the lowest and least specialized forms of life, have survived down to our own time. Thus he writes :[1]

The degree of differentiation and specialization of the parts in organic beings, when arrived at maturity, is the best standard, as yet suggested, of their degree of perfection or highness. As the specialization of parts is an advantage to each being, so natural selection will tend to render the organization of each being more

[1] *Origin of Species*, c. xi.

specialized and perfect, and in this sense higher; not but that it may leave many creatures with simple and unimproved structures fitted for simple conditions of life, and in some cases will even degrade or simplify the organization, yet leaving such degraded beings better fitted for their new walks of life.

By this fundamental test of victory in the battle of life, as well as by the standard of the specialization of organs, modern forms ought, on the theory of Natural Selection, to stand higher than ancient forms. Is this the case? A large number of palæontologists would answer in the affirmative; and it seems that this answer must be admitted as true, though difficult of proof.

That is to say, Natural Selection is just as ready to degrade as to elevate a creature, according to the actual requirements of the circumstances in which it is placed, and how far progress has been the rule, rather than stability or retrogression, is a question for geological history to determine. This we shall have to consider in our next chapter.

It is likewise obvious that so far as the mere struggle for existence is concerned, a species each of whose individual members is but poorly furnished, may nevertheless flourish unimpaired on the mere strength of its fecundity. It is thus, says M. Blanchard,[1] that the lower forms of life continue to hold their own despite the enormous ravages to which they are subject. The herring,

[1] *Op. cit.* p. 59.

for example, affords food to all the fowls of the air and fish of the sea, over and above the myriads annually requisitioned by man. Yet its hosts show no sign of being exterminated or even reduced. Much the same is the case of the cod; but a tribe one individual of which has been known to produce nine million eggs does not require much in the way of coherent heterogeneity to ensure its survival.

Thus it appears that of itself Darwinism affords no explanation whatever of the regular progression of life forms from lower to higher, to which the records of Nature bear witness, and which is the one solid fact suggesting the idea of Evolution.

Such are some of the reasons which, on purely rational grounds, appear amply to justify those who decline to pledge their faith to Darwinism, in spite of the popularity it enjoys. But what is to be said of the phenomena cited as furnishing positive and unimpeachable evidence in its favour, which were mentioned above in our sketch of its main features?

First as to the rudimentary, fragmentary, or vestigial organs so common in Nature. These, it is said, being of no possible advantage to their possessors, and often a serious disadvantage, can be explained only by supposing that they were serviceable in the past to the ancestral race whence these possessors are derived, and have since been superseded by other modifications of structure, so as to dwindle away by disuse. This, no doubt, seems a very plausible explanation, but it does not follow that we

ought immediately to adopt it as a certainty, instead of setting ourselves to examine how it accords with all the facts. Nothing is more dangerous and less scientific than to be in a hurry to conclude that everything is certain which seems to ourselves probable, especially if it suits a theory of our own. Unfortunately, this law is too frequently more honoured in the breach than the observance. In the present instance, Professor Haeckel himself furnishes an example. He is quite sure that the rudimentary structures can have but one significance, and that they are fatal to the idea of purpose in Nature, the object of his special aversion, and so he has proposed a new term, "Dysteleology," to embody this idea, of which he says,[1]

> *Dysteleology, or the theory of purposelessness* [is] the name I have given to the science of rudimentary organs, of suppressed and degenerated, aimless and inactive, parts of the body; one of the most important and most interesting branches of comparative anatomy, which, when rightly estimated, is alone sufficient to refute the fundamental error of the teleological and dualistic conception of Nature, and to serve as the foundation of the mechanical and monistic conception of the universe.

It will be sufficient to quote Professor Huxley's remarks upon this passage, taken from the very laudatory review he wrote of the work in which it occurs.[2]

[1] *History of Creation*, English Edition, ii. 353.

[2] *The Genealogy of Animals: a Review of Haeckel's "Natürliche Schöpfungs-Geschichte."* The *Academy*, 1869. Reprinted in *Critiques and Addresses*, and *Darwiniana* (Collected Works).

Professor Haeckel has invented a new and convenient name, "Dysteleology," for the study of the "purposelessnesses" which are observable in living organisms—such as the multitudinous cases of rudimentary and apparently useless structures. I confess, however, that it has often appeared to me that the facts of Dysteleology cut two ways. If we are to assume, as evolutionists in general do, that useless organs atrophy, such cases as the existence of lateral rudiments of toes in the foot of a horse place us in a dilemma. For, either these rudiments are of no use to the animal, in which case, considering that the horse has existed in its present form since the Pliocene epoch, they surely ought to have disappeared; or they are of some use to the animal, in which case they are of no use as arguments against Teleology. A similar, but stronger argument may be based upon the existence of teats, and even functional mammary glands in male mammals. . . . There can be little doubt that the mammary gland was as apparently useless in the remotest male mammalian ancestor of man as in living men, and yet it has not disappeared. Is it then still profitable to the male organism to retain it? Possibly; but in that case its dysteleological value is gone.

In later editions Professor Huxley further observed: "The recent discovery of the important part played by the Thyroid gland should be a warning to all speculators about useless organs."[1]

[1] The Thyroid gland in the throat, the function of which is unknown, was supposed to be absolutely without use. It is found, however, that its removal entails *myxoedema*, a condition closely allied to cretinism.

It seems, therefore, the wiser part to refrain from basing any vital conclusions upon these organs until we can assure ourselves that our knowledge warrants our so doing. As the same Professor Huxley intimated, it might be well for palæontologists, and doubtless for biologists likewise,[1] "To learn a little more carefully that scientific '*ars artium*,' the art of saying 'I don't know.'"

So again as to the phenomena of embryology. No doubt they are very striking and impressive. That the most highly developed creatures, and man himself, should in the first stages of existence exhibit the characteristics of lower forms, is an exemplification of development no less signal than the succession of ascending types witnessed to by the rocks. It is not easy to see, however, why it should be taken for granted that this can only signify genetic descent from all such forms, and that these embryo animals are engaged in climbing up their genealogical trees. Yet this is usually assumed as a matter of course, and any one who ventures to question the validity of such an inference, must be prepared to find himself accused of dogmatizing.

And yet, after all, upon what grounds does the assumption rest? That such a recapitulation of racial experiences forms no essential feature of Evolution is sufficiently evident from the case of the vegetable world,—for plants do not climb *their*

[1] "Geological Contemporaneity." (*Lay Sermons*, p. 206.)

genealogical trees, or pass in the seed through a series of botanical phases. And as to animals, since through all varieties of form, each always arrives at the required term, it is obvious that, apart from any archaic associations, and on Darwinian principles themselves, these forms must be the best for the purpose at each respective stage, —perhaps the only ones by which the term could be reached. It is therefore, to say the least, quite conceivable, that we have here the whole explanation and need go no further.

In certain instances this obvious consideration is strikingly illustrated. Thus the salamander, an Amphibian of the newt family, brings forth its young in adult condition without gills.[1] But previously to birth they have gills relatively large. The experiment having been tried of bringing some of them forth by artificial means before their time, and placing them in water, the first thing they did was to cast off these big gills, which were speedily replaced by new ones of much smaller size, and evidently better suited for the work required, as they lasted as long as a fortnight.

Here, in the first place, it is quite impossible to suppose that the large gills would continue to appear unless they were of advantage during the period of gestation. It is equally evident that it is not from a previous aquatic condition that they are inherited, for in such a condition they are useless. Finally, as Mr. Mivart observes, the new gills, suitable

[1] Mr. Mivart, *Types of Animal Life*, p. 113.

for unwonted conditions, were developed "not in a struggle for existence against rivals, but directly and spontaneously from the innate nature of the animal."

This view of the matter commended itself on mature consideration to so ardent an evolutionist as Carl Vogt, with whom we may couple M. de Quatrefages, who cites his words with approval as follows :[1]

> It has been laid down as a fundamental law of biogenesis that ontogeny (the development of the individual) and phylogeny (that of the race) must exactly correspond. . . . This law which I long held as well founded is absolutely and radically false. Attentive study of embryology shows us, in fact, that embryos have their own conditions suitable to themselves, very different from those of adults.

"In a word," M. de Quatrefages continues, "the learned Genevan professor rightly considers that, 'The ontogenesis of all organic beings without exception, is the normal result of all the various influences which operate upon such beings.'"

But it must, moreover, be noted that the story which embryology can be made to tell is by no means so plain as we might easily be led to suppose.

Thus, although snakes are held to be descended from lizards, and some of them have rudimentary legs even in the adult stage, others have no trace of limbs even in the egg, while they *have* vestiges

[1] *Les Emules de Darwin*, ii. 13.

of gills, and thus would seem to be visibly linked to ancient water-dwelling ancestors, and not to far more recent land-dwellers. Again;[1] Amphibians (frogs, newts and the like) agree in some respects, as to the development of the germ, with mammals, differing in the same respects from reptiles and birds. But reptiles and birds are supposed to be a more recent development than Amphibia, and therefore should intervene between them and mammals on the genealogical tree. Moreover the eggs of one group of Amphibians are found to exhibit some remarkable resemblances to those of reptiles and birds, from which it would thus appear to have derived them, although on other grounds it is declared to be of an older stock than theirs. Most frogs, toads, and newts come out of the egg as tadpoles, furnished with gills and so breathing in water. This should signify that these creatures are descended from fish or fishlike ancestors. But one frog (*Rana opisthodon*) is never a tadpole even in the egg, from which he gets out by means of a special opener on his snout which he has somehow acquired. On the other hand certain newts[2] breed as tadpoles instead of in their mature form, which looks like an attempt to climb down the tree instead of up.

It will be remembered that the latter phrase was that used by Professor Milnes Marshall. Yet even he expressed himself strongly concerning the

[1] Mr. Mivart, *Tablet*, April 21, 1888.

[2] The Mexican *Axolotl*, the *Triton Alpestris*, and probably others.

exaggerations of Professor Haeckel on this subject. In his review of Haeckel's *Anthropogenie*,[1] after observing that many descriptions of human embryology have been based on observations of dogs, pigs, rabbits, or even chickens and dogfish, he thus continued regarding the book before him:

A student who relied on Professor Haeckel's description, would obtain an entirely erroneous idea of the development of the human embryo. . . . It is a matter for great regret that a book of 900 pages, bearing such a title, should be allowed to appear, in which the account of the actual development of the human embryo is so inadequate or even erroneous.

Far more fundamental, however, is a remark of Mr. Mivart's, that if, as Darwinians say, the development of the individual is an epitome of that of the species, the latter must like the former be due to the action of definite innate laws unconsciously carrying out definite preordained ends and purposes. For although cells or embryos may be indistinguishable from one another, and may appear to us identical in constitution, their differences are absolute. Each is determined to be one sort of animal and no other, and can live at all only on condition of developing towards the prescribed form.—Therefore, whatever evidence the embryonic forms may be supposed to afford in support of Evolution, they have nothing in common with the haphazard process of Natural Selection.

[1] *Nature*, March 24, 1892.

And here again Professor Huxley found himself obliged to enter his *caveat*, and to intimate his opinion that some of his friends were inclined to build too confidently upon this foundation. As his biographer Professor Weldon writes in the *Dictionary of National Biography* :

Darwin had suggested an interpretation of the facts of embryology which led to the hope that a fuller knowledge of development might reveal the history of all the great groups of animals at least in its main outlines. This hope was of service as a stimulus to research, but the attempt to interpret the phenomena observed led to speculations which were often fanciful and always incapable of verification. Huxley was keenly sensible of the danger attending the use of a hypothetical explanation, leading to conclusions which cannot be experimentally tested, and he carefully avoided it. . . . In the preface to the *Manual of the Comparative Anatomy of Invertebrated Animals*, he says: "I have abstained from discussing questions of ætiology,[1] not because I underestimate their importance, or am insensible to the interest of the great problem of Evolution, but because, to my mind, the growing tendency to mix up ætiological speculations with morphological generalizations will, if unchecked, throw Biology into confusion."

Accordingly, Huxley himself based his faith in Evolution on palæontological evidence, and attempted to decide the precise course it had followed only "in the few cases where the evidence seemed

[1] i.e. the Science of Causes.

to him sufficiently complete." This line of enquiry we have still to pursue, but meanwhile, it is evident that the phenomena we have been considering, failing to meet the approval of so thoroughgoing an Evolutionist as he undoubtedly was, cannot be said to furnish convincing scientific evidence in favour of Darwinism.

It will be asked how it comes to pass, if the Darwinian system really lies open to so many objections, that it occupies so large a place in scientific estimation. To this we must reply that, in spite of its great name, its success has throughout been popular rather than truly scientific, and that as time went on it has lost ground among the class of men best qualified to judge. Evolutionists there are in plenty,—but very few genuine Darwinists, and amongst these can by no means be reckoned all who adopt the title, for not a few of them—as Romanes and Weismann—profess doctrines which cannot be reconciled with those of Darwin himself. Meanwhile, an increasing volume of scientific opinion sets definitely against Darwinism as an adequate explanation of the philosophy of life, and falls into the view expressed long ago by Charles Robin[1] who, as a freethinker, had no antecedent objections against it, "Darwinism is a fiction, a poetical accumulation of probabilities without proof, and of attractive explanations without demonstration.'

[1] *Dictionnaire encyclopédique des sciences médicales.*

It would be tedious to cite testimonies at length, but, in addition to M. de Quatrefages who has made a full and careful study of the whole question, [*Charles Darwin et ses précurseurs Français*, and *Les Émules de Darwin*] may be mentioned such continental scholars as Blanchard [*La vie des êtres animés*], Wigand [*Der Darwinismus und die Naturforschung*, etc.], Wolff [*Beiträge zur Kritik der darwinschen Lehre*], Hamann [*Entwicklungslehre und Darwinismus*], Pauly [*Wahres und Falsches an Darwins Lehre*], Driesch [*Biologisches Zentralblatt*, 1896 and 1902], Plate [*Bedeutung und Tragweite des Darwinschen Selektionsprincip*], Hertwig [*Address to Naturalist Congress, Aachen*, 1900], Heer [*Urwelt der Schweiz*], Kölliker [*Ueber die darwin'sche Schöpfungstheorie*], Eimer [*Entstehung der Arten*], Von Hartmann [*Wahrheit und Irrthum im Darwinismus*], Schilde [*Antidarwinistisches im Ausland*], Du Bois-Reymond [*Conference*, August 2, 1881, etc.], Virchow [*Freiheit der Wissenschaft*, etc.], Nägeli [*Mechanisch-physiologische Theorie der Abstammungslehre*], Schaafhausen [*Ueber die anthropologischen Fragen*], Fechner [*Ideen zur Schöpfungs-und Entwicklungsgeschichte der Organismen*], Jakob [*Der Mensch*, etc.], Diebolder [*Darwins Grundprinzip*, etc.], Huber [*Die Lehre Darwins kritisch betrachtet*], Joseph Ranke, and Von Bauer,—all of whom either reject Darwinism altogether, or admit it only with fatal reservations.

Special weight must attach to the adverse verdict of M. Fabre, styled by Darwin himself "that in-

imitable observer," who declares that he cannot reconcile the theory with the facts he encounters.[1]

It must be sufficient to quote one or two of our own countrymen, whose utterances will enable us to form an opinion as to the true scientific status of the doctrine.

We may begin with Huxley, the great popular champion of Darwinism, who did more than any other man to spread the new doctrine. Yet, strange to say, he seems never to have really accepted its fundamental tenet himself, always appearing very shy of Natural Selection, and carefully abstaining from committing himself to any responsibility for it. Thus in his treatise on *Man's Place in Nature*, he thus explains his position in its regard:

Mr. Darwin's hypothesis is not, so far as I am aware, inconsistent with any biological fact; on the contrary, if admitted, the facts of Development, of Comparative Anatomy, of Geographical Distribution, and of Palæontology, become connected together, and exhibit a meaning such as they never possessed before; and I, for one, am firmly convinced, that if not precisely true, that hypothesis is as near an approximation to the truth as, for example, the Copernican hypothesis was to the true theory of the planetary motions. But for all this, our acceptance of the Darwinian hypothesis must be provisional so long as one link in the chain of

[1] Thus having described in detail a series of experiments as to the effects of an alteration of diet supplied to the larvæ of various *hymenoptera*, M. Fabre writes:

"Tout cela est bien autrement grave que les petits riens invoqués par Darwin." (*Souvenirs entomologiques*, 3rd Series, p. 330.)

evidence is wanting; and so long as all the animals and plants certainly produced by selective breeding from a common stock are fertile with one another, the link will be wanting. For, so long, selective breeding will not be proved to be competent to do all that is required of it to produce natural species.

This missing link, like various others, has never been supplied, and in consequence Professor Huxley never abandoned his attitude of reserve. On the contrary, when, in 1880, he delivered an address to celebrate "the Coming of Age of the *Origin of Species*" he discharged the task without once mentioning Natural Selection, which is to that work as the Prince of Denmark is to *Hamlet*.

But there is one passage in the said address, which deserves to be specially remembered:

History warns us that it is the customary fate of new truths to begin as heresies and to end as superstitions; and, as matters now stand, it is hardly rash to anticipate that, in another twenty years, the new generation, educated under the influences of the present day, will be in danger of accepting the main doctrines of the *Origin of Species*, with as little reflection, and it may be with as little justification, as so many of our contemporaries, twenty years ago, rejected them.

In 1886, Professor Romanes pronounced as follows:[1]

"At present it would be impossible to find any working naturalist who supposes that survival of

[1] *Journal of Linnean Society*, vol. xix.

the fittest is competent to explain all the phenomena of species-formation."

As to the actual position now occupied in Scientific opinion by Mr. Darwin's hypotheses, we may content ourselves with the declaration of Professor S. H. Vines in his Presidential address to the Linnean Society, May 24, 1902.

1. It is established that Natural Selection, though it may have perpetuated species, cannot have originated any.

2. It is still a mystery why Evolution should tend from the lower to the higher, from simple to complex organisms.

3. The facts seem to admit of no other interpretation than that variation is not [as Darwin supposed] indeterminate, but that there is in living matter an inherent determination in favour of variation in the higher direction.

That is to say, Darwin's *Origin of Species* does not explain the Origin of Species; and as to the laws which govern Evolution we can be sure only that they are not those which he assigned.

In like manner, Sir Oliver Lodge pronounces:[1]

Take the origin of species by the persistence of favourable variations; how is the appearance of these same favourable variations accounted for? Except by artificial selection not at all. Given their appearance, their development by struggle and inheritance and survival can be explained; but that they arose spon-

[1] *Hibbert Journal*, January, 1903, p. 218.

taneously, by random changes without purpose, is an assertion which cannot be made.

We are thus in a position to form our own judgment as to the claim made on behalf of Mr. Darwin, with which we started this chapter—namely, that he has eliminated all mystery from the organic world by the discovery of natural mechanical laws by which all its operations are governed. It is, indeed, difficult to understand how Darwinists themselves can suppose their system to make any such claim, for, as M. Paul Vignon truly observes,[1] "La science darwinnienne s'imaginait avoir triomphé du Sphinx, alors qu'elle avait simplement décomposé le problème dans une monnaie d'énigmes moins rébarbatives en apparence." As has been said, it is far more on account of the vast consequences professedly based upon it, as a sure foundation stone, than for its own sake, that it has seemed advisable to devote so much attention to the study of Darwinism, quite apart from which the whole question of organic Evolution still demands consideration.

It seems far more just to conclude with M. Fabre:[2]

Let us acknowledge that in truth we know nothing about anything, so far as ultimate truths are concerned. Scientifically considered nature is a riddle to which human curiosity can find no answer. Hypothesis follows hypothesis, the ruins of theories are piled one on another, but truth ever escapes us. To learn how to remain in ignorance may well be the final lesson of wisdom.[3]

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1 *Revue de Philosophie*, April 1, 1904.

2 *Souvenirs entomologiques*, 3rd Series, p. 317.

3 For some further testimonies on this head see Appendix.

XVI

THE FACTS OF EVOLUTION

LEAVING the field of speculation and "ætiology," we have now to enquire, not to what causes organic Evolution may be attributable, but how far it can be shewn to have actually occurred. This can be learnt only from the history of life upon earth as disclosed by the evidence of palæontology, or the geological record, and we are thus brought to the investigation of that evidence, by which alone, as Professor Huxley agrees, can the truth about Evolution be scientifically or satisfactorily established. In his address recently mentioned on occasion of the twenty-first birthday of the *Origin of Species*, having spoken of various advances of our knowledge, as in comparative anatomy and embryology, which had helped to win acceptance for transformist doctrines, he thus continued:

> But all this remains mere secondary evidence. It may remove dissent, but it does not compel assent. Primary and direct evidence in favour of evolution can be furnished only by palæontology. The geological record, so soon as it approaches completeness, must, when properly questioned, yield either an affirmative

or a negative answer; if evolution has taken place, there will its mark be left; if it has not taken place, there will be its refutation.

This is common sense. Evolution can claim to be a scientific truth, only so far as clear evidence is forthcoming that Evolution there has been. If the geological record be sufficiently complete to prove or disprove its claims, the question is settled for ever. If, on the other hand, the record be not complete enough for a conclusive verdict, it is, at least, hard to understand the grounds of such a statement as that the doctrine of Evolution has long since passed beyond the stage of discussion among scientific thinkers;[1] or that of Professor Marsh, that to doubt Evolution is to doubt Science; or of Professor Huxley himself[2]—"So far as the animal world is concerned, Evolution is no longer a speculation, but a matter of historical fact."

This historical enquiry is accordingly all-important, and it is one which should be easy to undertake without any prepossessions, for it is hard to see upon what *à priori* grounds these could rest. That there has been Evolution in one sense of the term is obvious,—that is to say, development of organic types from lower to higher forms, from the sea-weed or fungus to the oak or the rose, from the star-fish or the coral-insect, to the eagle or to man. The question is, not whether there has been such a

[1] *Nature*, September 10, 1891.

[2] *Coming of Age of the Origin of Species.*

progressive succession of forms, but whether one form has proceeded from another *genetically*, being produced in the same manner as individuals of a species now are. That this has been the case, as Professor Huxley tells us in the same address, is the cornerstone of evolutionary teaching. He appears indeed to restrict Evolution within the limits of classes and groups, but such restriction is so contrary to all his principles that the words which seem to imply it can scarcely be taken as having any definite significance. Should the appearance of different classes and groups require to be severally accounted for, we should be landed back in the system of separate creations against which he is never tired of inveighing.

> The fundamental doctrine of all forms of the theory of evolution applied to biology [he says] is that the innumerable species, genera, and families of organic beings with which the world is peopled have all descended, each within its own class or group, from common parents, and have all been modified in the course of descent.

And, holding as he does that palæontology furnishes the necessary evidence, he thus continues:

> And, in the view of the facts of geology, it follows that all living animals and plants are the lineal descendants of those which lived long before the Silurian epoch.

Here is a plain issue, and one, as has been said, to be discussed without prejudice. That the in-

numerable forms of organic life should thus have been genetically derived one from another, is no more difficult to conceive than that they should have come into existence at all. Moreover, it appears to our minds almost a first principle that natural law must suffice to account for the phenomena of nature from beginning to end, and that any system is self-condemned which finds anywhere in these phenomena evidence of a non-natural, or supernatural, interposition. Has not such a theologian as Suarez, following St. Augustine, laid it down as an axiom [1] that God does not directly interfere with the operations of Nature, when He can effect His purposes through natural causes? Undoubtedly, too, it is difficult for our minds to imagine in what way, except through genetic evolution, the successive production of more and more developed types could be effected.

But, as has before been observed, what seems to us probable is not therefore proved to be true. What we want are facts, and by facts we must be ready to abide. At the same time, it is not very easy to understand the supreme importance which evolutionists generally appear to attach to the descent of all living creatures from some *one* original, and their abhorrence of the idea that the power, whatever it was, which first produced life, may have operated repeatedly, at different epochs, to repeat the production. It seems to be assumed that this must imply "miracle"

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[1] *De opere sex dierum*, ii. 10, n. 12.

and interruption of the continuity of Nature, to admit which is irrational and unscientific. But since life did unquestionably once originate somehow, which Science makes no attempt to deny, why should it be so improper to suppose that it originated more than once, at various times and in various forms, and that, consequently, genetic descent with modification, or "Evolution," is not the explanation of typic development? As Sir J. W. Dawson writes[1] concerning the oyster tribe, whereof two species are found in the Coal Measures (one European and the other American), and a continuous succession of species ever since:

> All these species may have proceeded from one origin, by descent with modification, or, on the other hand, the same causes which led to their origination in the Carboniferous may have operated again and again.

It must, however, be remembered that, if the theory of genetic descent with accumulation of minute modifications be the true explanation of the production of new forms, it necessarily follows, that could a complete record be forthcoming of the ancestry of any actual species, there would be found in that pedigree no distinction of species or genera, for no sharply marked lines of limitation would be discoverable. It would be like the case of a man who had been photographed every hour of his life from birth to old age;—immense though the difference

[1] *Modern Idea of Evolution*, p. 97.

might be between the two extremes, the gradations of change would at all points pass as imperceptibly into one another as do the phases of the moon. This consideration is both fundamental and obvious, yet it would seem to be almost universally ignored. It appears to be thought that, in order to demonstrate the fact of evolution, all that is needed is to find a form here and there, in some sense intermediate between others,—like the reptilian birds already mentioned. This would imply that the course of Evolution must be like that of an army, making long marches from point to point, and traceable only by the remains of its camp-fires: whereas it should be as that of a glacier continuously creeping on, and leaving its tracks at one point as much as another. What are wanted, therefore, as evidence for Evolution, are not isolated specific forms uniting some characteristics of those which they are supposed to connect,—as Nelson's men-of-war form a stepping-stone between the vessels of the Norsemen and the ironclads of the present day,—but a series sufficient to show, or at least to indicate, that all changes have been gradual and insensible, without the introduction at any point of a new element. To pursue the illustration, such a new element would be gunpowder or steam in the evolution of the battle-ship, for by no mere development could bows or javelins produce a cannon, or sailing ships a steamboat.

Therefore, in proportion as the geological record approaches completeness, its testimony,—if it is

to be in favour of Evolution—must tend more and more in this direction, and unless, in some instance at least, clear evidence be discoverable of the melting of one form into another, it cannot possibly be said that we have sufficient proof that such a process ever occurred. Mere graduated resemblance of isolated forms does not necessarily imply such transmutation, as we see for example in the methodical progression of shape, exhibited by various crystals, and even more remarkably in the affinities which we can recognize among what we know as elementary substances.

There is another important point to be borne in mind. According to the teaching of Evolutionists such as Darwin or Haeckel,[1] every Species has originated from a single ancestor,—or, as they should rather say, from a single pair.

If this were so, it would necessarily follow that every new form, originating in some particular spot of earth, would very gradually spread thence to other regions, fighting its way along. As Mr. Darwin acknowledges,[2] "The development by this

[1] Darwin (*Origin of Species*, p. 274, 6th Edition) considers it "incredible" that the same identical species should originate twice even under the very same conditions. In the following passage, Haeckel affirms such unity of origin in respect of a most remarkable species of wide-reaching affinities.

"All morphologists arrive at the firm conviction that all vertebrata, from the *Amphioxus* upwards to man himself, all fishes, amphibia, reptiles, birds, and mammals, descend originally from a single vertebrate ancestor, for we cannot imagine that all the different and highly complicated conditions of life which, through a long series of processes or stages of development, led to the typical formation of a vertebrate, have accidentally happened together more than once in the course of the earth's history." (Address to Munich meeting of German Association, vid. *Nature*, October 4, 1877.)

[2] *Origin of Species* (6th Edition), p. 265.

means (i.e. Natural Selection) of a group of forms, all of which are descended from some one progenitor, must have been an extremely slow process; and the progenitors must have lived long before their modified descendants."

Of this gradual spread of new types there should, at least in some cases, be some palæontological evidence.

It is likewise by no means easy to understand how species thus generated could stand solitary and isolated from kindred forms in the records of the earth. The pair of individuals which started a new persistent group,—its members all stamped with the same specific characters, while all around were in a state of flux and divergence,—differed from their immediate ancestors, as we have seen, only infinitesimally. They can have differed no more from many of their contemporaries, for all the lines of descent must ramify afresh in each generation, and so form a web rather than anything like a line. It is not very easy to understand how a pair here and there struck root and founded a species, while the thousands which jostled them round about failed to do so, for the others which survived longest must be supposed to have resembled them most nearly, and therefore to have participated in their advantages. At least, we should expect to find around them the débris of the multitude they vanquished in the struggle for existence.

We are told, moreover, that, with hardly an exception, the organic forms found in a fossil state

must be supposed to be the last of their special line of development, which terminated in them; so that neither can they be claimed as the direct ancestors of any other forms, fossil or living, nor can any others which are actually known be claimed as their progenitors. The genealogies supplied for almost all known species, extinct or existing, are admittedly conjectural, and as in the most famous instance of all, namely the supposed common ancestor of simians and men, the links are persistently "missing." Thus M. de Quatrefages, speaking of the human pedigree as set forth by Professor Haeckel, writes thus:[1]

All species, existing or extinct, are said to have been preceded by *ancestral forms* which have disappeared without leaving the slightest vestige behind them. The *amphioxus* itself, which more than any other realizes the type of the group it represents, was preceded, according to Haeckel, by the *provertebrate*, which no man has ever seen, but of which, nevertheless, the Jena professor gives us a figure, and describes the anatomy.

Thus the number of forms postulated by the theory of genetic Evolution, must have been enormous beyond conception, in comparison with those belonging to the numerically insignificant groups which formed the mere extremities of branches on the genealogical tree.

[1] *Les Emules de Darwin*, ii., 76.

This being premised, we must ask what Geology has to tell us on the subject, and it will be well to begin by briefly recalling the main features of the geological record.

The stratified rocks comprising the crust of the earth, in which fossil plants and animals are found embedded, have evidently been formed at successive periods, chiefly by the agency of water, each formation having begun as a sediment like the mud or ooze at the bottom of our oceans and seas. Geological investigation has proved that the chronological order of the strata thus deposited can be satisfactorily determined, and they are found to divide themselves, in respect of the organisms they contain, into three great series, lying above the *Azoic* (or lifeless) rocks, older than them all.

These series, beginning from the bottom, in which order we shall have to trace their history, are most conveniently named *Primary*, *Secondary*, and *Tertiary*, otherwise termed respectively, *Palæozoic* ("ancient life"), *Mesozoic* ("middle life"), and *Kainozoic* ("recent life"). Each of these again, contains various formations, or as we may call them volumes of its chronicle, each of which has its fixed place in order of sequence.

Thus, always proceeding from below upwards, in the *Primary* series, commencing with the *Laurentian*, we find successively the *Huronian*, *Cambrian*, *Silurian*, *Devonian* or *Old Red Sandstone*, *Carboniferous*, and *Permian*.

In the *Secondary*, the lowest formation is the *Triassic* or *New Red Sandstone*, followed by the *Jurassic* or *Oolite*, and the *Cretaceous* or *Chalk*.

Finally the *Tertiary* has three main divisions; the *Eocene*, or "dawn of the recent," *Miocene*, or "less recent," and *Pliocene*, or "more recent."

Above these comes the series now in progress, variously called, *Quaternary*, *Post-Tertiary*, and *Pleistocene*, or "most recent."

It seems advisable to begin our investigation with the vegetable kingdom, as its classification being comparatively simple, the essential points of its development are easily followed. We cannot do better than start with the summary of its main divisions furnished by Mr. Carruthers.[1]

The vegetable kingdom is divided into sections, according to the simplicity or complexity of structure. Associated with plants of simple structure we find, as a rule, more elementary organs of reproduction. Linnaeus made two great divisions, of flowering (*Phanerogams*) and flowerless plants (*Cryptogams*). . . . The higher group have flowers, with their stamens and pistils, which produce seeds, while the lower group are without flowers and bear spores, which are much simpler bodies than seeds. There are seven main groups of spore-bearers—the *algæ* or water-weeds; the *fungi* or mushroom family; the *lichens*, which cover old walls and rocks with patches of coloured vegetation; the *mosses* with their green leaves and urn-shaped fruit; the *ferns* with

[1] *History of Plant Life and its bearings on Theory of Evolution* (1898).

their large and usually much-divided leaves, on the back or edges of which the spores are borne; the *horse-tails*, found in wet places, having jointed hollow stems and spores produced in little cones; and the *club-mosses*, upright or creeping leafy plants found on our mountains. These seven groups may be arranged in two divisions, according to the tissues of which they are formed. In the first four the whole plant is composed of *cells*, while in the last three a firm *vascular skeleton* is present. These characters are of great importance to the student of fossil plants. . . . The flowering plants are more complex in their structure, and in their organs of reproduction. The lowest group of these plants is the *Gymnosperms*, or naked-seeded plants, like our yews and pines. The other flowering plants (*Angiosperms*) have their seeds in a closed fruit. These are divided into two sections from characters derived from the embryo plant in the seed, depending on whether this minute plant has one seed-leaf (*cotyledon*) or two, and so we have *Monocotyledons* and *Dicotyledons*. The higher group, or dicotyledons, have been arranged into three divisions, according to the complexity of the flower. In one large group (*Apetalae*) the pistil and stamens are not surrounded by petals, e.g. in the oak and the stinging nettle: superior to them are the plants (*Monopetalae*) in which the petals form a cup, as the blue-bell [1] and the gentian, while the highest group (*Polypetalae*) have all the petals separate, as the buttercups and roses.[2]

1 Harebell.

2 According to the most recent system of classification, the Monopetalæ, now re-christened *Sympetalae*, are ranked above the Polypetalæ, the family of the *Compositae* being highest of all.

It is most important to recollect that on evolutionary principles the first representatives of any such classes—and the same holds of animals as well—must have been generalized forms, representing the type in the rough, or, in Mr. Herbert Spencer's phrase, exhibiting by comparison with their successors indefinite incoherent homogeneity, as contrasted with definite coherent heterogeneity. They should bear the same sort of relation to the finished articles worked up by Evolution as did the first bone-shaker bicycle to our latest patterns, or the news-sheets of Cromwell's time to the *Times* or *Graphic* of to-day. On this, as we saw in the last chapter, Mr. Darwin strongly insists, confessing at the same time that the Geological record alone can establish such progress as a fact.

How these various classes of plants appear actually to have come upon the scene, Mr. Carruthers relates both in the paper from which we have just quoted, and at greater length in the address which he delivered as President of the Geologists' Association,[1] to the following effect.

In the first place, he declares that although the geological record, at least as known to us, is very imperfect, and represents only an insignificant fragment of plant-history,

There is a large series of plant-remains completely

[1] *Proceedings*, vol. v., p. 17, etc. (1875–6). The substance of this address appeared as an article in the *Contemporary Review*, February, 1877, entitled, "Evolution and the Vegetable Kingdom."

and accurately known which supply a fair representation of the great events of plant-life that have taken place on the earth since Palæozoic times. And these are more than sufficient to establish or destroy this hypothesis [of genetic evolution] by their testimony.

There is—he goes on to say—indirect evidence of the existence of vegetable life, long before we find any actual remains. Such indirect evidence is afforded in the first place by the abundance during this period of animal life, needing plants for its sustenance, and secondly by the enormous quantity of carbon in the rocks, which must have been secreted from the atmosphere by vegetable tissues. There are also certain surface marks or impressions occasionally to be found, which are probably due to plants of a soft and perishable character like the cellular cryptogams, and which although extremely vague and undefined, at least do not contradict the evolutionist, who regards them as evidence that the *Algæ* were, as according to him they ought to have been, the primeval plants. Mr. Carruthers adds a caution however, which can find its application in other instances as well:

While making this admission in relation to the vegetation of these older rocks, I must protest against the practice of completing the record of life forms, by filling in particular groups without any authority except the writer's impression of an adopted hypothesis, and then basing arguments on these assumptions in support of the hypothesis which created them. So completely has

VEGETABLE DEVELOPMENT.

	Post Tertiary.	
Tertiary.	Pliocene.	
	Miocene.	
	Eocene.	
Secondary.	Chalk.	Dicotyledons (Apetalæ, Polypetalæ, Sympetalæ).
	Oolite.	
	Trias.	
Primary.	Permian.	
	Carboniferous.	Monocotyledons.
	Devonian, or Old Red Sandstone.	Clubmosses, Horsetails, Ferns, Gymnosperms.
	Silurian.	Cellular Cryptogams.
	Cambrian.	
	Huronian.	Indications of Plants, not determinable.
	Laurentian.	
	Azoic.	

phylogenetic [or racial] evolution become the creed of some leading naturalists that they unwittingly proceed in this manifestly unphilosophical method. But it is a first axiom, though one often forgotten, in this as in every scientific enquiry, that no step can be made in advance which is not based on fact.

After this initial stage, the story becomes much clearer, and at the same time less easy to reconcile with evolutionary requirements.

Instead of making their appearance singly and successively, and passing imperceptibly one into another, all three groups of Vascular Cryptogams, and the Gymnosperms into the bargain, come on the stage together, in the Devonian strata; and Monocotyledons in the lower Carboniferous immediately following. There is no trace whatever of the development of any of these forms from the earlier cellular cryptogams:

But [says Mr. Carruthers] the evolution of the Vascular Cryptogams, and the Phanerogams, from the green seaweeds, through the liverworts and mosses, if it took place, must have been carried on through a long succession of ages, and by an innumerable series of advancing steps; and yet we find not a single trace either of the early water forms or of the later and still more numerous dry-land forms. The conditions that permitted the preservation of the fucoids in the Llandovery rocks at Malvern, and of similar cellular organisms elsewhere, were, at least, fitted to preserve *some* record of the necessarily rich floras, if they existed, which through

immense ages, led by minute steps to the Conifer [*Gymnosperm*] and Monocotyledon of these Palæozoic Rocks.

Further, these earliest plants are not generalized forms of the various tribes to which they belong, but they are as highly specialized as any subsequent representatives of the particular group to which they belong, and wherever they differ from later plants, it is in the possession of a more perfect organization.

From all which facts Mr. Carruthers thus argues:

The complete absence of intermediate forms, and the sudden and contemporaneous appearance of highly organized and widely separated groups, deprive the hypothesis of genetic evolution of any countenance from the plant-record of these ancient rocks. The whole evidence is against evolution, and there is none for it.[1]

Dicotyledons furnish evidence of especial value. On account of their higher organization, they are easily distinguished from both Monocotyledons and Gymnosperms; and they present features which clearly differentiate them amongst themselves. They did not make their entry till after a long interval—and their remains are therefore to be found in strata comparatively recent and better known to us than those of the older rocks. It is in the Chalk, the newest of the Secondary or Mesozoic formations, that they first exhibit themselves, and they do it in the same fashion as their predecessors.

[1] See Appendix B. p. 284.

When the Dicotyledons appear in the upper cretaceous beds, representatives of the three great groups [*Apetalæ*, *Monopetalæ*, *Polypetalæ*] appear together in the same deposit. Moreover, these divisions are represented, not by generalized types, but by differentiated forms, which, during the intervening epochs, have not developed even into higher generic groups.

And, here again, there is no vestige of intermediate species, linking dicotyledonous plants with other types.

No trace of a plant belonging to this great division has yet been detected in any earlier stratum [than the upper chalk]. There is no evidence whatever for Haeckel's statement that the *Apetalæ* probably existed in the Triassic and Jurassic periods. . . It cannot be doubted that the conditions favourable to the preservation of Monocotyledons and Equisetums would have secured the preservation of some of the *Apetalæ*, had they existed. This absence can be accounted for only on the supposition that they formed no part of the then existing vegetation. And in the deposits older than the Trias, or in any subsequent deposits, no intermediate form has been detected,—no Gymnosperm or Monocotyledon which exhibits in any point of its structure a modification towards the more highly organized Dicotyledon.

Nor, on the same authority, is this all.

It is equally important in its bearing on the hypothesis of genetic evolution that the generic groups above named

have persisted from the first known appearance of Dicotyledons, throughout the whole of the intervening ages, and still hold their places unchanged among the existing forms of vegetation. The persistence of generic and specific types, and the certain knowledge we possess of the life of many existing species of Phanerogams and Cryptogams which have come down through the Glacial Epoch, have not been sufficiently considered in their bearing on the hypothesis.

We have already seen something of an example which illustrates this point in a remarkable manner, —that of *Salix polaris*, the willow which has so obstinately preserved its specific identity amid great stress of circumstances. It belongs to a very variable genus—one in which if anywhere evidence of genetic development might be looked for. Yet it is found that since a period prior to the great Ice Age, or Glacial epoch, it has remained absolutely unchanged. At such a rate, we cannot but ask, how long would Evolution take to get back to the generalized type-form, or common ancestor, of the genus *Salix*, and then to that of the Order *Salicineae*, which includes poplars as well as willows. "The Ordinal form, if it ever existed, must necessarily be much older than the period of the upper Cretaceous rocks, that is than the period to which the earliest known Dicotyledons belong."

And it is obvious that when we had got back to the parental stock of the willow tribe, we should still, as evolutionists, be separated by a gulf still vastly greater from the common ancestor of all

Dicotyledons, of oaks, apple-trees, primroses, and daisies no less than of willows and poplars.

The significance of all these various facts is thus summed up:

> The whole evidence supplied by fossil plants is, then, opposed to the hypothesis of genetic evolution, and especially the sudden and simultaneous appearance of the most highly organized plants at particular stages in the past history of the globe, and the entire absence amongst fossil plants of any forms intermediate between existing classes or families. The facts of palæontological botany are opposed to Evolution, but they testify to Development, to progression from lower to higher types. The cellular Algæ preceded the Vascular Cryptogams and the Gymnosperms of the Newer Palæozoic rocks, and these were speedily followed by Monocotyledons, and, at a much later period, by Dicotyledons. But the earliest representatives of these various sections of the vegetable kingdom were not generalized forms, but as highly organized as recent forms, and in many cases more highly organized: and the divisions were as clearly bounded in their essential characters, and as decidedly separated from each other as they are at the present day.

So much for the vegetable world. As for the animal, although the number and complexity of its divisions makes it less easy to present so complete a sketch in these moderate limits, the features of its history are very similar. As Sir J. W. Dawson recounts it:[1]

[1] *Modern Ideas of Evolution* (6th Edition), pp. 107, seq.

ANIMAL DEVELOPMENT.

	Post Tertiary.	Man and Modern Mammals.
Tertiary.	Pliocene.	
	Miocene.	
	Eocene.	Placental Mammals (Ungulates, Unguiculates, Rodents, Whales, Bats).
Secondary.	Chalk.	
	Oolite.	Birds.
	Trias.	Marsupial Mammals.
Primary.	Permian.	Reptiles (various orders).
	Carboniferous.	
	Devonian, or Old Red Sandstone.	Millipeds, Insects, Spiders, Scorpions, Fish, Batrachians, etc.
	Silurian.	
	Cambrian.	Shell Fish, Sponges, Molluscs, Crustaceans, Worms, etc.
	Huronian.	Protozoa.
	Laurentian.	
	Azoic.	

In the Cambrian age, we obtain a vast and varied accession of living things, which appear at once, as if by a sudden and simultaneous production of many kinds of animals. Here we find evidence that the sea swarmed with creatures near akin to those which still inhabit it, and nearly as varied. . . . Had we been able to drop our dredge into the Cambrian or Silurian ocean, we should have brought up representatives of all the leading types of invertebrate life that exist in the modern seas—different, it is true, in details of structure from those now existing, but constructed on the same principles, and filling the same places in nature.

In the latter half of the Palæozoic we find a number of higher forms breaking upon us with the same apparent suddenness as in the case of the early Cambrian animals. Fishes appear, and soon abound in a great variety of species, representing types of no mean rank, but, singularly enough, belonging in many cases to groups now very rare; while the commoner tribes of modern fish do not appear. On the land, Batrachian Reptiles now abound, some of them very high in the sub-class to which they belong. Scorpions, spiders, insects, and millipedes appear as well as land-snails: and this not in one locality only, but over the whole northern hemisphere. . . . Nor do they show any signs of an unformed or imperfect state. . . . The compound eyes and filmy wings of insects, the teeth, bones, and scales of batrachians and fishes; all are as perfectly finished, and many quite as complex and elegant, as the animals of the present day.

This wonderful Palæozoic age was, however, but a temporary state of the earth. It passed away, and was

replaced by the Mesozoic, emphatically the age of Reptiles, when animals of that type attained to colossal magnitude, to variety of function and structure, to diversity of habitat in sea and on land, altogether unexampled in their degraded descendants of modern times. . . . Strangely enough, with these reptilian lords appeared a few small and lowly mammals, forerunners of the coming age.[1] Birds also made their appearance.

The Kainozoic, or Tertiary, is the age of Mammals and of Man. In it the great reptilian tyrants of the Mesozoic disappear, and are replaced on land and sea by mammals or beasts of the same orders with those now living, though differing as to genera and species. So greatly indeed did mammalian life abound in this period that in the middle part of the Tertiary most of the leading groups were represented by more numerous species than at present, while many types then existing

[1] These first mammals, which were exceedingly small, are supposed by most naturalists to have been Marsupials. They would appear presently to have become extinct, no traces of them having been found in the chalk, a formation so rich in other organic remains. As Professor Marsh tells us on this subject (*Nature*, September 27, 1877, p. 471):

"Of the existence of Mammals before the Trias we have no evidence, either in the New or the Old World, and it is a significant fact that at essentially the same horizon in each hemisphere similar low forms of Mammals make their appearance. Although only a few incomplete specimens have been discovered, they are characteristic and well preserved, and all are apparently marsupials; the lowest mammalian group known in America, living or fossil. The American Triassic mammals are known at present only from two small lower jaws, on which has been founded the genus *Dromotherium*, supposed to be related to the insect-eating *Myrmecobius*, now living in Australia. Although the fauna of Europe have yielded other similar mammals for the Oolite, America has as yet none of this class from that formation, while from the rocks of cretaceous age, no mammals are known in any part of the world."

have now no representatives. At the close of this great and wonderful procession of living beings comes Man himself—the last and crowning triumph of creation the head, thus far, of life on the earth.

It must be sufficient to quote one other remark: [1]

There is no direct evidence that in the course of geological time one species has been gradually or suddenly changed into another. . . . On the other hand, we constantly find species replaced by others entirely new, and this without any transition. The two classes of facts are essentially different, though often confounded by evolutionists; and though it is possible to point out in the newer geological formations some genera and species allied to others which have preceded them, and to suppose that the later forms proceeded from the earlier, still, as the connecting links cannot be found, this is mere supposition, not scientific certainty. Further, it proceeds on the principle of arbitrary choice of certain forms out of many, without any evidence of genetic connexion.

Having given a tabular view of Geological periods and Life-epochs, similar to those presented above, our author remarks: [2]

If in the table above we were to represent diagrammatically the development of animals and plants, this would appear not as a smooth and continuous stream, but as a series of great waves, each rising abruptly, and then descending and flowing on at a lower level along with the remains of those preceding it.

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[1] P. 118. [2] P. 105.

And here may be noticed an observation made amongst others by the Comte de Saporta[1] on the remarkable parallelism of Animal and Vegetable development. After a period in which these kingdoms were respectively represented by aquatic *Algæ* and *Protozoa*, land animals and land plants appear to have come in much at the same epoch; and afterwards dicotyledonous plants immediately preceded the advent of mammals.

Mr. Mivart is of like mind with the others we have heard. "The mass of palæontological evidence," he writes,[2] "is indeed overwhelmingly against minute and gradual modification." He points out, with the *North British* Reviewer so frequently quoted, that had the later forms of life descended from the earlier, through such a series of imperceptible gradations as is imagined, the probability would be that no two fossil specimens would be exactly alike, whereas in fact numbers are found of certain particular patterns, and none whatever between them, fossil animals and plants falling naturally into species, genera, families, and other categories just like those of the present day.

It is this total absence of graduated series, linking different forms together, that is the great and fundamental difficulty in the way of genetic evolution. Yet this seems very seldom to be realized, and it seems constantly to be assumed that in order to establish the genetic continuity of two creatures

[1] *Le monde des plantes avant l'apparition de l'homme*, p. 34.
[2] *Genesis of Species*, p. 129.

no more is required than to discover another standing more or less between them. Thus in the most famous of all instances, how often do we hear of "the missing link" between man and ape,—as though should a generalized form be disclosed, which might be considered a common ancestor, the question of man's simian origin would be finally settled. In the same way, as we have seen, the existence of birds with reptilian features, is taken by some as conclusive proof that birds and reptiles have descended from one stock. But what is most imperatively wanted, is persistently wanting,—namely some evidence of a series in which one form passes to another, as in a dissolving view. And yet, genetic evolutionists must suppose such series to have been the universal rule throughout the whole course of life on earth.

> Assuredly [writes M. de Quatrefages][1] is it not singularly unfortunate for the evolutionary theory that so many facts which tell against it should have been preserved in the scraps of Nature's great book which remain to us, and that invariably those which would have told in its favour were recorded in lost volumes and missing leaves ?

In some particular instances the absence of any trace of intermediate forms is especially significant. The tribe of Bats, for instance, is a very singular one. The wings, in which form the fore-limbs are specialized, represent the same elements as our own

[1] *Charles Darwin*, p. 185.

hands; and other modifications of the same members have produced the paws of cats and dogs, the hoofs of horses and cattle, and the flippers of whales and porpoises,—to mention no others. What countless hosts of the Bat's ancestors must have lived and died while by accumulation of minute differences the primitive generalized limb whence all these diverse forms originated, was being turned into a wing capable of flight. Yet of all these no vestige is to be discovered. "Whenever the remains of bats have been found," says Mr. Mivart,[1] "they have presented the exact type of existing forms." The same, he tells us, holds good of other flying creatures—birds and pterodactyles—(or flying lizards—now wholly extinct). No trace of any of these is forthcoming while their wings were in the making. "Yet had such a slow mode of origin as Darwinians [and genetic evolutionists generally] contend for, operated exclusively in all cases, it is absolutely incredible that bats, birds, and pterodactyles should have left the remains they have, and yet not a single relic be preserved in any one instance of any of these different forms of wing in their incipient and relatively imperfect functional condition!"

There are other creatures which stand in solitary isolation, with no fragments of a bridge to connect them with the general body. Such is the rattlesnake's family, whose pedigree, Mr. Mivart declares,[2] we cannot even imagine—"The ancestors

[1] *Genesis of Species*, p. 130.
[2] *Types of Animal Life*, 149.

of the rattlesnake are beyond our mental vision."

But the number of forms [says the same author][1] represented by many individuals, yet by ***no transitional ones***, is so great that only two or three can be selected as examples. Thus those remarkable fossil reptiles, the Icthyosauria and Plesiosauria, extended, through the secondary period, probably over the greater part of the globe. Yet no single transitional form has yet been met with in spite of the multitudinous individuals preserved. Again, with their modern representatives the Cetacea, one or two aberrant forms alone have been found, but no series of transitional ones indicating minutely the line of descent. This group, the whales, is a very marked one, and it is curious, on Darwinian principles, that so few instances tending to indicate its mode of origin should have presented themselves. Here, as in the bats, we might surely expect that some relics of unquestionably incipient stages of its development would have been left.

Professor W. C. Williamson likewise remarks [2] on these *lacunæ* which persistently occur at crucial points:

If [he writes] these generic types [of plants] first came before us in such clearly defined forms, when and where did the transitional states make their appearance? The extreme evolutionists constantly affirm of those

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1 *Genesis of Species*, p. 132.

2 "Primeval Vegetation in its relation to the Doctrine of Natural Selection and Evolution" (*Essays and Addresses*, Owen's College, Manchester, p. 251).

who believe in special creation that they "habitually suppose the origination to occur in some region remote from human observation," and that "the conception survives only in connexion with imagined places where the order of organic phenomena is unknown." It is legitimate to retort upon them that they as habitually resort to "strata now covered by the sea"—to rocks "from which all traces of such fossils as they probably included have been obliterated by igneous action," and to mysterious "migrations from pre-existing continents to continents that were step by step emerging from the ocean." Unfortunately, so far as the vegetable kingdom is concerned, we have as yet failed to discover any traces of these mysterious strata or hypothetical continents in which the transitions from one plant-type to another were being brought about. The believers in special creations are not the only reasoners who have made free use of hypothetical possibilities.

He presently adds:

We have no evidence that unaided Nature has produced a single new type during the historic period. We can only conclude that the wonderful outburst of genetic activity which characterized the Tertiary age was due to some unknown factor, which then operated with an energy to which the earth was a stranger, both previously and subsequently. The knowledge of this factor is what we need in order to perfect our philosophy; and until we obtain that knowledge, many things must remain unaccounted for, so far as primeval vegetation is concerned.

And elsewhere Professor Williamson reiterates the same idea :[1]

I contend stoutly [he says] that, however numerous may be the facts that sustain the doctrine of evolution (and I am prepared to admit that there are many that do so in a remarkable manner), this unexplained outburst of new life demands the recognition of some factor not hitherto admitted into the calculations of the evolutionist school.

In the record of fossil fishes he finds some features which are particularly hard to harmonize with any theory of genetic evolution.[2] Amongst the very earliest representatives of this class, even in the upper Silurian, are found remains of sharks, in his opinion the highest order of fish, and in the Devonian and Carboniferous above, of *Ganoids*, armour clad, like the sturgeon. But nowhere below the Chalk do we find a single scale of *Cycloids* or *Ctenoids*, which in regard alike of the scales themselves, of the nervous system and of the reproductive organs, are much below the sharks, and not above the *Ganoids*. To complicate matters still more, however, the skeleton of *Cycloids* and *Ctenoids* is more highly organized than that of the others, and it is thus equally impossible to describe them as progressive or as retrogressive types.[3]

Over and above this absence of intermediate or link forms, the witnesses who have been cited insist

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1 "Succession of Life on Earth." (*Half-hour Recreations*, 2nd Series, p. 329.)

2 *Essays and Addresses*, Owen's College, Manchester, p. 220, note.

3 See note, p. 238.

on the fact that those earliest found are not simple or generalized representatives of their respective types, as the theory of genetic evolution requires them to be, but are as perfectly finished and specialized as those appearing in later ages. To their testimony on this point may be added that of Professor Huxley, who while frankly confessing that he would be glad enough to find evidence in favour of such progressive modification, was constrained by his love of scientific truth to bear witness as follows:[1]

The only safe and unquestionable testimony we can procure—positive evidence—fails to demonstrate any sort of progressive modification towards a less embryonic, or less generalized type, in a great many groups of animals of long-continued geological existence. In these groups there is abundant evidence of variation—none of what is generally understood as progression; and if the known geological record is to be regarded as even any considerable fragment of the whole, it is inconceivable that any theory of a necessarily progressive development can stand, for the numerous orders and families cited afford no trace of such a process.

So again he declared at a later period[2] summarizing what he had said previously:

In answer to the question, What does an impartial survey of the positively ascertained truths of palæon-

[1] "Geological Contemporaneity," 1862. (*Lay Sermons*, p. 222.)
[2] "Palæontology and Evolution," 1876. (*Critiques and Addresses*, p. 182.)

tology testify in relation to the common doctrines of progressive modification? . . . I reply: It negatives these doctrines; for it either shows us no evidence of such modification, or demonstrates such modification as has occurred to have been very slight; and as to the nature of that modification, it yields no evidence whatsoever that the earliest members of a long-existing group were more generalized in structure than the later ones.

He went on, however, to say, on this latter occasion, that discoveries made in the interval afforded much ground for softening "the Brutus-like severity" which eight years before he had exhibited in this regard, by disclosing such evidence as he had declared to be lacking. From the samples, however, which he produced, it does not appear that this fresh testimony comes to very much; and in view of the observations with which he accompanied the exposition, it would seem that in only one instance did it appear to himself thoroughly satisfactory.

Every fossil [he said][1] which takes an intermediate place between forms of life already known, may be said, so far as it is intermediate, to be evidence in favour of Evolution, inasmuch as it shows a possible road by which Evolution may have taken place. But the mere discovery of such a form does not, in itself, prove that Evolution took place by and through it, nor does

[1] P. 187.

it constitute more than presumptive evidence in favour of Evolution in general.

It is easy[1] to accumulate probabilities—hard to make out some particular case in such a way that it will stand rigorous criticism. After much search, however, I think that such a case is to be made out in favour of the pedigree of the Horse.

Of this famous instance we have already heard, and since it will be examined at length in the following chapter, we will not dwell further upon it here.

So obvious indeed is this deficiency for evolutionary requirements of the Geological record, that Professor Haeckel attempts to supply the want by boldly interpolating a number of periods during which the metamorphoses occurred, but of which no record was left. He assumes that between the epochs of depression, when fossils were deposited beneath the water, there were other epochs of elevation when the land was dry and no deposits could occur, and he supposes that the abrupt changes of flora and fauna exhibited by successive formations, are due to the lapse of time of which we have no organic record in what he styles these "Ante-periods."

As to this summary mode of loosing the Gordian knot, it will be sufficient to quote Professor Huxley's verdict: "I confess this is wholly incredible to me."[2] And although in his favourable review of Haeckel's book[3] he showed himself far more tolerant of

[1] P. 192.

[2] *Genealogy of Animals.* [3] *Natural History of Creation.*

gratuitous speculations, than his utterances on other occasions might have led us to expect, upon this point he declared: "I fundamentally and entirely disagree with Professor Haeckel."

We may sum up the testimonies of which the above are representative in the words of two authorities by no means hostile to Evolution. M. Edmond Perrier,[1] having shewn how this theory is suggested by the successive developments of type, and how the phenomena of organic life seem to harmonize with it, thus continues:

> Unfortunately, when we descend to details, such palæontological gaps present themselves that every sort of objection is possible. The chain which morphology has allowed us to piece together is continually snapped when we essay to travel back into the past. . . . The art of distinguishing realities from phantoms of the imagination is what has made modern science so great and so mighty. She is strong enough to win honour by avowing ignorance, and because men see her always determined to speak the truth, they gradually realize that she is not dangerous.

And in his Presidential address to the Linnean Society, May 24, 1902, Professor S. H. Vines thus expressed himself as to the genealogical table of organic life, which ever since the doctrine of Evolution was accepted, it has been sought to construct:

> Though here and there fragments of the mosaic

[1] *Le Transformisme*, pp. 337–340.

seem to have been successfully pieced together, the main outlines, even, of the great picture are as yet but dimly discernible.

The fact that organic Evolution should have proceeded so far as it has within such limits of time as may reasonably be allowed, admits, to my mind, of no other interpretation than that variation is not indeterminate, but, as Lamarck and Nägeli have urged, there must exist in living matter a certain inherent tendency or bias in favour of variation in the higher direction. It is this tendency or bias that I venture to regard as the primordial factor.

But it is precisely such an inherent tendency of organic life to develop on predetermined lines, which Darwinians and other advocates of Evolution by the agency of physical forces alone, vehemently repudiate as fatal to their whole system.

[Since Professor Williamson wrote, the opinion has been adopted that for the very reason which induced him to place the Sharks above the *Cycloids* and *Ctenoids*, their relative positions should be reversed. The Sharks being a more "generalized" type, with features more akin to those of land-dwelling reptiles, and the others more "specialized" for purely aquatic conditions, the latter, it is argued, are a higher evolutionary product. As a necessary corollary it is assumed that vertebrate life originated, not, as had been supposed, in the sea, but in swamps or lagoons on the shore-line. It must, however, remain a question how far the facility with which theories can thus be modified according to requirements, is calculated to inspire confidence in them.]

XVII

"AUDI ALTERAM PARTEM"

We have heard Mr. Carruthers' declaration, based upon his survey of palæontological botany, "The whole evidence is against Evolution, and there is none in favour of it."

Remarkably enough, at almost the same period [1] Professor Huxley concluded a discussion of palæontological evidence with a precisely contrary pronouncement—"The whole evidence is in favour of Evolution, and there is none against it." On other occasions, also, he distinctly maintained that it is just this line of enquiry which conclusively establishes Evolution as no longer a theory, but an historical fact. To such a conclusion, he tells us,[2] "an acute and critical-minded investigator is led by the facts of palæontology;"—and, again, "If the doctrine of Evolution had not existed, palæontologists must have invented it, so irresistibly is it forced upon the mind by the study of the remains of the Tertiary mammalia."

Such declarations clearly challenge consideration,

[1] *Lectures on Evolution*, New York, 1876. Cheap Edition, p. 43.

[2] *Coming of Age of the Origin of Species*, etc.

especially when it is remembered how strict were the views which Professor Huxley professed as to the necessity of proofs for our beliefs,—"that it is wrong for a man to say he is certain of the objective truth of any proposition unless he can produce evidence which logically justifies that certainty."[1]

We therefore turn naturally to his lectures on Evolution, wherein he treats the palæontological argument *ex professo*, and we find that his verdict is based upon a few selected instances, such as that of the reptilian birds already mentioned, which he considers favourable to Evolution, and one which he terms *demonstrative*,—namely that of the Horse. This he treats in some detail; in regard of it he delivers the positive judgment which we have just heard, and it therefore in a special manner demands our attention.

As furnishing evidence for the history of the horse, two features are of special importance, his limbs, and his teeth. Of these we may confine our attention to the former, as being, at once, sufficient for our purpose, and within the scope of ordinary observation.

The horse family, or *Equidae*, belong to the tribe of Ungulates, or hoofed animals, some points of whose anatomy require to be considered in relation to our own.

Taking first the fore-limbs. What we call the "knee" of a horse is in reality the wrist,—the true

[1] *Essays on Controverted Questions*, p. 450.

knee, or rather elbow, being what we call the "shoulder." Below the knee comes the "cannon bone," corresponding to the middle bone of the hand, and below it the "pastern," "coronary," and "coffin" bones, representing the joints of the solitary middle-finger, while the hoof is its greatly enlarged and thickened nail. Similarly, in the hind-limbs; the "hock" is veritably the ankle, and again the lateral digits are suppressed, the middle toe alone remaining.

It thus appears that an Ungulate such as the horse, is an extreme modification of the general Mammalian plan, his members being highly specialized for a certain kind of work. His leg and hoof, as the theory of genetic Evolution declares, have been gradually fashioned to their present shape from an original limb in the common Mammalian ancestor, which by other modifications has equally produced the totally different members possessed by other mammals.

That the horse is descended from a race bearing more than one digit on each extremity, seems to be indicated by the splint-bones which are found on the cannon-bone of both fore and hind legs, and which represent the second and fourth finger and toe, and also by recorded occurrences of polydactyle horses, one of which has a distinguished place in history as Julius Cæsar's charger.[1]

[1] "Utebatur autem equo insigni, pedibus prope humanis, et in modum digitorum ungulis fissis; quem natum apud se, cum haruspices imperium orbis terrae significare domino pronuntiassent, magna cura aluit." (Suetonius, *Julius*, 61.)

That the animal as we now know him is the lineal descendant of various other ungulates, in whom the digits were gradually reduced from the normal number of five, to their present solitary representative, Professor Huxley and other Evolutionists hold to be demonstrated by the discovery in due succession of various equine specimens, in which this diminution is gradually exhibited.

The remains of these animals are all found in *Tertiary* strata, of which, it will be remembered, there are three great divisions, the *Eocene*, *Miocene*, and *Pliocene*, the first named being the most ancient, and the last the most recent.

The genus *Equus*, or at least our modern horse, *Equus caballus*, can be traced no further back than the *Post-tertiary* period. The succession of forms leading up thither commences at the bottom of the *Eocene*, and extends to the upper *Pliocene*.

Following Professor Huxley's guidance, we trace the pedigree downwards, thus:

Firstly, there is the true horse. Next we have the American Pliocene form, *Pliohippus*. In the conformation of its limbs it presents some very slight deviations from the ordinary horse. Then comes *Protohippus*, which represents the European *Hipparion*, having one large digit and two small ones on each foot . . . But it is more valuable than *Hipparion*, for certain peculiarities tend to show that the latter is rather a member of a collateral branch, than a form in the direct line of succession. Next, in the backward order in time, is the *Miohippus*, [*Miocene*], which corresponds pretty nearly

with the *Anchitherium* of Europe. It presents three complete toes — one large median and two smaller lateral ones; and there is a rudiment of that digit which answers to the little finger of the human hand. The European record stops here: in the American Tertiaries, the series of ancestral equine forms is continued into the Eocene. An older Miocene form, *Mesohippus*, has three toes in front, with a large splint-like rudiment representing the little finger, and three toes behind. The *radius* and *ulna*, *tibia* and *fibula*,[1] are distinct. Most important of all is the *Orohippus*, from the Eocene. Here we find four complete toes on the front limb, three toes on the hind-limb, a well developed *ulna*, a well developed *fibula*.

Here, when the lecture which we are considering was delivered, the series terminated:—and upon the facts as above given Professor Huxley thus commented:

Thus, it has become evident that, so far as our present knowledge extends, the history of the horse-type is exactly and precisely that which could have been predicted from a knowledge of the principles of Evolution. And the knowledge we now possess justifies us completely in the anticipation, that when the still lower Eocene deposits, and those which belong to the Cretaceous Epoch have yielded up their remains, we shall find, first, a form with four complete toes and a rudiment of the innermost or first digit in front, with probably a

[1] The *radius* and *ulna* are the two bones of the forearm above the wrist; the *tibia* and *fibula* the corresponding bones of the leg above the ankle. In the horse, the *ulna* and *fibula* are almost, but not quite, lost.

rudiment of the fifth digit in the hind foot; while, in still older forms, the series of the digits will be more and more complete, until we come to the five-toed animals, in which, if the doctrine of Evolution is well founded, the whole series must have taken its origin.

Finally he was able to add in a note that since the delivery of the lecture, Professor Marsh had discovered a new genus of Equine Mammals, *Eohippus*, corresponding very nearly to his description of what might first be looked for. "This," adds Professor Huxley, "is what I mean by demonstrative evidence of Evolution. . . . In fact, the whole evidence is in favour of Evolution, and there is none against it."

That these facts are indeed most remarkable and deserving of all attention, cannot be questioned. But before we can agree that they are conclusive and demonstrative in Professor Huxley's sense a good many considerations require to be carefully weighed.

(i.) It is obvious, in the first place, that here as in all other instances which we have seen, the one thing is lacking which is really wanted in order to prove Evolution, namely evidence of one species gradually shading off into another. The creatures of which we have heard, are each isolated from the rest, and indeed very much isolated, for each belongs to a different *genus*,[1] which shows that the differences

[1] Animals and plants are placed in different *species* when the differences between them are only *relative*; in different *genera*, when

between them are substantial. They are, in fact, farther apart from one another, than the zebra or the donkey from the horse, for both of these are classed in the genus *equus*,—or than the Bengal tiger is from the domestic pussy-cat, both belonging to the genus *felis*.

These various ungulate forms thus stand a long way from one another, and if they were once connected together by a bridge, or rather a causeway, we ought certainly to find some traces of it, and not always of those particular types which require to be united. If we suppose the very distinct species actually known to have been the piers of such a bridge, yet what has become of the arches ? Till some vestiges of these be found, or, at least, some positive evidence that arches there actually were, can it be said that the story of the fossil *equidae* furnishes convincing testimony on behalf of the supposed evolution ? Affinities these various forms undoubtedly exhibit: it has yet to be shown that affinities necessarily imply descent.

There is, however, something even more remarkable. We have seen that Professor Huxley prognosticated beforehand the discovery of *Eohippus*, and specified pretty nearly the features it would be found to present. In the same way, Professor Marsh [1] anticipates and describes a still more remote ancestral form, for which, though it has not yet been

such differences are *absolute*. Thus, for example, the size of teeth is considered relative ; the number of teeth absolute.

[1] *American Journal of Science and Arts*, 3rd Series, vol. 43 (1892), p.351.

found, he has provided an appellation, *Hippops*. But if either Professor really believes in Evolution, why does he take for granted that we shall chance upon one particular form, standing like a solitary outpost by itself, and not upon any other trace of the stream of life whereof it was but one transient phase? Such predictions may be evidence that the occurrence of these progressive forms is regulated by something analogous to Bode's Law of inter-planetary distances, and that their discovery may be looked for at certain intervals. But the very fact that their actual position can be so accurately specified serves to show that it is very definitely fixed.

(ii.) Moreover, a very grave difficulty at once suggests itself, of which Professor Huxley makes no mention. The horse as we now have him, *Equus caballus*, is a native of the Old World, and has been introduced to America only since the time of Columbus. There had, it is true, been horses in America previously,—belonging to the genus *Equus*, perhaps even to the species *caballus*,—they had, however, been long extinct, and no memory of them remained. But, as will be noticed, the pedigree given by Professor Huxley consists almost entirely of American animals, to which category belong all whose names terminate in *-hippus*, and these cannot with any reason be assigned as progenitors to the European horse. As Sir J. W. Dawson observes: [1]

[1] *Modern Ideas of Evolution*, p. 119.

In America a series of horse-like animals has been selected, beginning with the *Eohippus* of the Eocene—an animal the size of a fox, and with four toes in front and three behind—and these have been marshalled as the ancestors of the fossil horses of America. . . . Yet all this is purely arbitrary, and dependent merely on a succession of genera more and more closely resembling the modern horse being procurable from successive Tertiary deposits often widely separated in time and place. In Europe, on the other hand, the ancestry of the horse has been traced back to *Palæotherium*—an entirely different form—by just as likely indications, the truth being that as the group to which the horse belongs culminated in the early Tertiary times, the animal has too many imaginary ancestors. Both genealogies can scarcely be true, and there is no actual proof of either. The existing American horses, which are of European origin, are, according to the theory, descendants of *Palæotherium*, not of *Eohippus*; but if we had not known this on historical evidence, there would have been nothing to prevent us from tracing them to the latter animal. This simple consideration alone is sufficient to show that such genealogies are not of the nature of scientific evidence.

(iii.) Even apart from this fundamental difficulty, there is much diversity as to the precise genealogy. We may compare together the lines of ancestry favoured—(1) by Professor Huxley, (2) In a case exhibited in our Museum of Natural History to illustrate the subject, (3) By Mr. Mivart,[1] (4) By

[1] *Types of Animal Life*, 205.

Mr. Lydekker,[1] (5) In *The Evolution of the Horse*, a pamphlet issued, January, 1903, by the American Museum. This last gives the very latest version of the pedigree, but, naturally, of the American Horse alone.

Huxley.	*British Museum Case.*	*Mivart.*	*Lydekker.*	*American Museum.*
Equus	Equus	Equus	Equus	Equus
Pliohippus				
Protohippus	Hipparion	Hipparion	Hipparion	Hipparion
		Protohippus	Protohippus	Hypohippus
Miohippus		Anchitherium	Anchitherium	Merychippus
Anchitherium	Anchitherium	Pachynolophus	Anchilophus	Mesohippus
Mesohippus	Protohippus		(*form allied to*)	(2 *species*)
Orohippus	Mesohippus			Epihippus
	(2 *species*)		Hyracotherium	Protorohippus
Eohippus	Hyracotherium	Phenacodus	Systemodon	Eohippus
				An undiscovered ancestor (Hippops)

It will be observed, that whereas *Hipparion* is disallowed by Professor Huxley as not being in the direct line of descent, in all the other genealogies he appears as the immediate ancestor of *Equus*. Also that in all these tables, Old World and New World forms are used indifferently to supply progenitors for the same successor. Also that there is no agreement at all as to the earlier ancestry. It would likewise appear that even the existence of *Eohippus* himself is not beyond question, for in our Museum galleries and guide-book his name always has a note of interrogation appended. The American authorities give an anticipatory sketch of the limbs of the ancestor which still remains to be discovered.

There is something even more remarkable.

[1] Nicholson and Lydekker's *Manual of Palæontology*, ii. 1362.

DEVELOPMENT OF EQUIDÆ.

	Recent.	Equus Caballus.*
	Quaternary.	Equus Stenonis.*‡ E. Sivalensis.*‡ &c. Hippidium.‡ E. Americanus.‡ &c.
TERTIARY.	Pliocene.	Pliohippus. Hipparion.*‡ Protohippus.
TERTIARY.	Miocene.	Hypohippus. Parahippus. Miohippus. Anchitherium.* Merychippus. Mesohippus.
TERTIARY.	Eocene.	Epihippus. Orohippus. Hyracotherium.* Protorohippus. Pachynolophus.* Eohippus. Phenacodus.
	SECONDARY.	Hippops (undiscovered). No trace of Mammals except small Marsupials and Insectivora.

* Indicates an inhabitant of the Old World. All others are American.

‡ "Not in direct line of ancestry."

Huxley's lecture exhibiting the pedigree we have been considering was delivered in 1876. We have already seen that six years earlier he had declared himself satisfied, after much search, that though other genealogies might be doubtful, we had in the case of the Horse something really satisfactory. But the pedigree of 1870—which he thus indicated as scientifically established—was totally different from that of 1876, and was acknowledged as erroneous by the very acceptance of the latter. In 1870 the ancestry presented for *Equus* consisted of *Hipparion*, *Anchitherium*, and *Plagiolophus*. Of these, *Hipparion* was in 1876 specifically disallowed as a direct ancestor: *Anchitherium* was displaced by *Miohippus*, and although we are told that these creatures "correspond pretty nearly," the Horse cannot be descended from *both*, especially as they dwelt in different hemispheres. Finally *Plagiolophus* disappears from the amended pedigree altogether. Nothing could more vividly illustrate the danger of such speculations than that an authority so clear-headed and conscientious as Professor Huxley should thus proclaim his acceptance of a genealogy which he had on after information to renounce. Nor to him alone have such misadventures happened. Mr. Darwin too thought the claim of *Hipparion* to ancestral equine rank to be beyond dispute. "No one will deny," he wrote,[1] "that the *Hipparion* is intermediate between the

[1] *Origin of Species*, c. xi.

existing horse and certain older ungulate forms." Yet, as we see, this has been denied by his champion Huxley himself.

(iv.) The materials available for the reconstruction of these various equine forms, are far less satisfactory than might easily be supposed. As a rule, each is known to us only by small fragments of its skeleton, so that we can have no assurance as to what the whole animal was really like, or even that all parts assigned to one creature really belonged to him. We can accordingly feel no certainty that if we could see any of these as a whole we should find it possible to suppose that the horse descended from it. Thus in *Hippidium*, an American genus closely allied to *Equus*, it is at least doubtful whether the digits did not terminate in claws.[1] One species of *Hippidium* is known only by a solitary tooth. Of *Hyracotherium* only the skull has been found: of *Orohippus* only parts of jaws and teeth and a fore-foot: of *Epihippus*, "only incomplete specimens."[2] Accordingly, Professor Williamson, speaking of the discoveries of Professor Marsh and others, thus expresses himself:[3]

> Beyond all question, some of the gaps that have hitherto separated the three animals [*Anchitherium*, *Hipparion*, and *Equus*] are filled up by these discoveries; but I want yet more evidence before I can arrive at the

[1] *Lydekker*, p. 1361.

[2] *Evolution of the Horse*, 12.

[3] "Succession of Life on Earth" (*Recreations in Popular Science*, 2nd Series, p. 339).

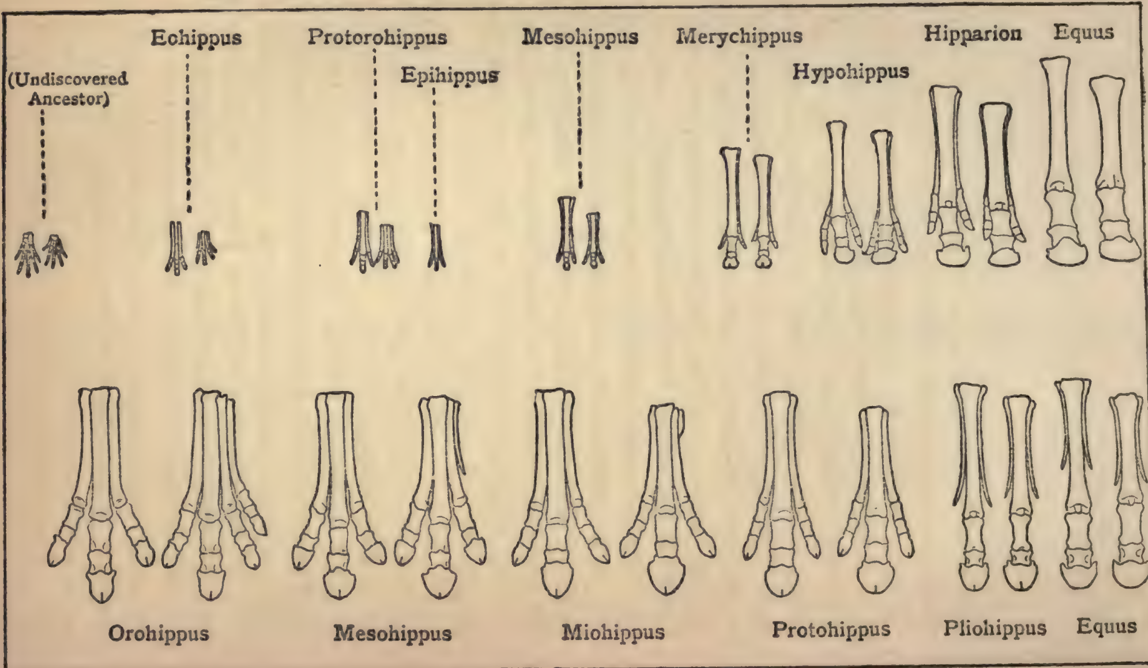
conclusion that the doctrine of Evolution is proved by these facts beyond the possibility of question. It appears to me that before I can unhesitatingly give to the testimony of these fossil horses the full value I am asked to do, I must know more about them than is at present possible. It will not be enough that the limbs and teeth of these creatures indicate transmutation, but such transmutation must be evidenced by every part of the animal. This demand is especially applicable to the stages which intervene between the Hipparion and the horse. . . . Myriads of individuals must have existed to effect the gradual shading of the one into the other in every part of its body.

(v.) It should likewise be remarked that in one not unimportant particular, the plates so commonly given to illustrate the horse's ancestry do not fairly represent the facts. It would appear from them that all the animals were much of a size, which doubtless greatly assists the imagination in picturing them as all in one line of descent. But as a matter of fact they differed in stature extremely, and the remoter supposed progenitors were comparative pigmies. *Hyracotherium*, for instance, was "about the size of a hare,"[1] and according to Professor Cope, *Orohippus* was the exact counterpart of this diminutive steed. The hypothetical *Hippops*, which Professor Marsh locates in the lower Tertiary or upper Secondary rocks, can, he thinks,[2] now "be predicated with

[1] British Museum (*Nat. Hist.*) *Guide to fossil mammals and birds*, p. 38.

[2] *American Journal of Science and Art*, 3rd Series, vol. 43 (1892), p. 351.

"THE PEDIGREE OF THE HORSE," FROM THE AMERICAN MUSEUM.



"THE PEDIGREE OF THE HORSE," FROM HUXLEY'S *LECTURES ON EVOLUTION.*

(Hind and fore limb of each species, when forthcoming.)

certainty;" and amongst other things it "probably was not larger than a rabbit, perhaps much smaller." Sometimes, so far as evidence goes, it even seems that in respect of size there was deterioration instead of advance as the lineage progressed. Thus *Epihippus*, found in the Upper Eocene, is considerably smaller than *Protorohippus*, found in the Middle Eocene; "but," says the American pamphlet,[1] "no doubt there were others of larger size living at the same time," which will scarcely be called convincing.

(vi.) Worthy of notice also is "the remarkable circumstance that in the line of evolution culminating in the modern Horse, a parallel series of generically identical or closely allied forms occurs in the Tertiaries of both Europe and North America, from which it has been suggested that on both continents a parallel development of the same genera has simultaneously taken place."[2] And, as we have seen, while the American pedigree must have been entirely different from the European, it terminates equally in both continents with the genus *Equus*, if not actually with *Equus caballus*.[3] But, on any mechanical system of evolution, it is impossible to suppose that developments conducted along separate roads could thus be brought to meet in one terminus.[4] Mr. Darwin did not con-

[1] *The Evolution of the Horse*, p. 16.

[2] *Lydekker, ut sup.* p. 1363.

[3] Sir W. Flower, *The Horse*, p. 74.

[4] "It is a consequence of the theory of Natural Selection that identity of structure involves community of descent; a given result can only

ceive it possible that the same species should be produced twice over, "if even the very same conditions of life, organic and inorganic should recur,"[1] and the production of genuine horses, not only in widely diverse circumstances, but through totally different ancestors, must appear still less conceivable. Consequently, says Mr. Mivart,[2] "it follows from this generic identity, that classification will be no longer Darwinian, but one more Aristotelian, and will regard, not the origin but the *outcome* of development, whether of the individual or the species."

(vii.) There is, however, another consideration more serious than any of the above. In order to set the theory of genetic Evolution upon a sound and substantial basis, it is not sufficient to show that the last ungulate is lineally descended from the first,—*Equus* from *Eohippus*, *Hyracotherium*, *Phenacodus*, or *Hippops*,—but that this first ungulate himself—whichever it was—has been, or at least may have been, similarly developed from a non-ungulate Mammalian ancestor, the common parent of all the protean forms assumed by his progeny. To develop all these from one original, through a graduated series in each case, by the infinitesimal process of descent with modification, would require a period

be arrived at through a given sequence of events; the same morphological goal cannot be reached by two independent paths." Milnes Marshall, *Biological Lectures*, 247.

1 *Origin of Species*, c. xi. "Geological Succession of Organic Beings."

2 *Tablet*, April 21, 1888, p. 637.

of time inconceivably long—immensely longer than that required to change one ungulate into another. Ungulates, as has been said, are a highly specialized type of Mammals, and although they walked on the nails of five digits instead of only one, a vast amount of Evolution would be required to bring them even to this point, from that whence all Mammals are said to have started. There must also have existed, while this development was in progress, a teeming and multitudinous mammalian life, as raw material for its operations—and of this at least *some* trace should remain.

But, so far as we know, the first Ungulates made their appearance upon earth quite as soon as did any other mammals from which they could possibly have sprung. *Phenacodus*, is in fact described as,[1] "The most primitive Eocene mammal yet discovered." He appears in the Lower Tertiary; while the Secondary and Mesozoic rocks beneath,—the whole period covered by which would be none too long for the evolution of Tertiary mammals generally,—are practically devoid of mammalian remains altogether, exhibiting only a few small marsupials, from which we can no more suppose *Phenacodus* and the huge and various beasts who were his Eocene contemporaries to have developed, than from opossums the size of shrew-mice.

It also complicates matters not a little to find that when placental mammals first show them-

[1] *Catalogue of Mammals*, etc., *ut sup.* p. 38.

selves all over the world at the beginning of the Eocene,—while this highly specialized order of the Ungulates seems to have been much the most numerous, it had a host of contemporaries, of extreme diversities of structure:—as for instance Unguiculates (or clawed animals) allied to the Hyena and the Fox, Rodents (gnawing animals) akin to the Squirrel, as well as Whales and Bats. Of the Cetaceans, Sir J. W. Dawson tells us:[1]

> The oldest of the whales are in their dentition more perfect than any of their successors, since their teeth are each implanted by two roots, and have serrated crowns, like those of the seals. The great Eocene whales of the South Atlantic (*Zeuglodon*) which have these characters, attained the length of seventy feet, and are undoubtedly the first of the whales in rank as well as in time. This is perhaps one of the most difficult facts to explain on the theory of Evolution. . . . "We may question," says Gaudry,[2] "these strange and gigantic sovereigns of the Tertiary oceans as to their progenitors—they leave us without reply." . . . Their silence is the more significant as one can scarcely suppose these animals to have been nurtured in any limited or secluded space in the early stages of their development.

The Bats, as is obvious, would require quite as much transformation from the generalized mammalian type as the Whales themselves, though in quite

[1] *Chain of Life*, p. 222.

[2] *Les Enchainements du Monde Animal* . . . Mammifères Tertiaires.

another direction. But they appear with their wings fully developed, in the Eocene, in both Hemispheres.

Gaudry thinks [writes Sir J. W. Dawson][1] that it is "natural to suppose" that there must have been species existing previously with shorter fingers[2] and rudimentary wings; but there are no facts to support this supposition, which is the more questionable since the supposed rudimentary wings would be useless, and perhaps harmful to their possessors. Besides, if from the Eocene to the present, the Bats have remained the same, how long would it take to develop an animal with ordinary feet, like those of a shrew, into a bat?

Such instances are by no means singular, nor are like difficulties confined to the Eocene. In the Miocene above, about the time when Anchitherium flourished, there appeared a family with whom he might claim relationship, for they were not only akin to the Ungulates but Perissodactyles, or "odd-toed," like himself. These were the "Proboscideae"—"the beasts that bear between their eyes a serpent for a hand," in other words the Elephants and their allies. These, like other families, amongst their earliest representatives included the giants of their race, for some of their Miocene specimens[3] are about half as large again as

[1] *Chain of Life*, 227.

[2] It is the "fingers" of the bat's "hand" which support the wing membrane. Hence the scientific name *Cheiroptera*.

[3] E.g. Dinotherium giganteum and Elephas meridionalis. (Vid. Gaudry, *op. cit.* 169.)

the largest of our modern elephants. Professor Ray Lankester has recently declared [1] that we now understand the genetic affinities of these creatures, whose faces have been pulled out into trunks with the nose at the extremity, and in support of his statement he adduces the features of the cranium as exhibited in certain recently-discovered specimens. But how far can conclusions be called final which are based upon such partial evidence ? [2] As M. Gaudry, convinced Evolutionist as he is, acknowledges, in regard of this very matter: [3]

> Like the Mastodons, the Dinotheria appeared suddenly. Whence did they come ? from what quadrupeds did they spring ? At present we do not know. . . . The points of difference [from other mammals] taken as a whole, and compared with the points of resemblance, are too great to enable us to point to any relationship between the Proboscideans and animals of other orders as yet known to us.

Such then are some of the still unanswered questions connected with the genesis of the Horse, "the most famous instance of geological evi-

[1] Lecture at Royal Institution, January 2, 1904.

[2] A remarkable instance of the need of caution is furnished by the history of the Dinotherium itself. From the teeth, first found, Cuvier set down the animal as a monster Tapir. Then, a whole skull being discovered, Herr Kaup of Darmstadt, commenting upon the danger of such a proceeding, himself classed the beast among the Edentata (Sloths, etc.), and afterwards among the Hippopotami. Buckland and Strauss thought it must have been an aquatic creature ; Blainville and Pictet labelled it a Manatee, or sea-cow. (Vid. Gaudry, *op. cit.* 187–9.)

[3] *Op. cit.* p. 191.

dence "[1] which Professor Huxley selects as proving Evolution to demonstration. It is by no means easy to understand how it could ever be supposed to merit any such description. In view of the various difficulties recited above it can hardly be thought that there is satisfactory evidence even of the modicum of Evolution for which alone are such arguments brought, namely within the limits of the *Equidæ*. Even were the reality of this established to the full, how would such evidence compare with that we have heard, drawn not from one corner of Organic Nature, but from a review of the great lines of its history ?[2]

We find indeed that while Professor Huxley declares palæontology to be the main support of Evolution, other authorities tell us the exact contrary.

> The doctrine of organic evolution [says Sir J. W. Dawson][3] is essentially biological rather than geological, and has been much more favoured by biologists than by those whose studies lead them more specially to consider the succession of animals and plants revealed by the rocks of the earth.

Similarly Professor Williamson,[4] speaking of the efforts made to obtain evidence on behalf of Evolution, says: "Not only living, but extinct animals

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[1] Milnes Marshall, *Lectures on Darwinian Theory*, p. 66.
[2] See Appendix C. p. 285.
[3] *Modern Ideas of Evolution*, c. iv.
[4] "Primeval Vegetation in its relation to the Doctrine of Natural Selection and Evolution." (*Essays and Addresses*, Owen's College, Manchester, p. 200.)

have been appealed to; Professor Huxley especially has, with his wonted skilfulness, made use of the latter to buttress the geological side of the structure, which is confessedly its weakest one."

More important than all,—Mr. Darwin himself fully acknowledged that the palæontological evidence is far short of what it should be:—and attempted to meet the difficulty by pleading the imperfection of the geological record:—a plea to be more fully considered presently.

We must not leave unnoticed the method of dealing with the geological record adopted by Professor Haeckel. Of this we have already seen a slight specimen,—in the gratuitous and baseless assertion that the apetalous Dicotyledons date as far back as the Trias, at the very bottom of the Secondary period, by which, were it a fact, a serious Evolutionary void would be filled. In the same manner he draws a perfectly imaginary picture of the submarine forests of primeval days, in which "we may suppose" all the forms of after vegetation to have begun their career as seaweeds.[1]

But in regard of his favourite doctrine of the bestial origin of man, he goes much further, and prints[2] an elaborate genealogy upon which Professor Huxley in reviewing him makes no adverse remark. In this he exhibits, as a simple matter of scientific fact, an "Ancestral Series of the human pedigree," which ninety-nine per cent. of his readers

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1 *History of Creation*, ii. 92, English Edition.

2 *Ibid.*, p. 295.

will naturally suppose to be based upon palæontological evidence. This wonderful genealogy stands thus:

1. *Monera.* 2. Single-celled Primeval animals. 3. Many-celled Primeval animals. 4. Ciliated planulæ (*Planæada*). 5. Primeval Intestinal animals (*Gastræada*). 6. Gliding Worms (*Turbellaria*). 7. Soft-worms (*Scolecida*). 8. Sack worms (*Himatega*). 9. *Acrania.* 10. *Monorrhina.* 11. Primeval fish (*Selachii*). 12. Salamander fish (*Dipneusta*). 13. Gilled Amphibia (*Sozobranchia*). 14. Tailed Amphibia (*Sozura*). 15. Primeval Amniota (*Protamnia*). 16. Primary Mammals (*Promammalia*). 17. *Marsupialia.* 18. Semi-apes (*Prosimiæ*). 19. Tailed narrow-nosed Apes. 20. Tail-less narrow-nosed Apes (Men-like Apes). 21. *Pithecanthropus* (Speechless or Ape-like Man). 22. Talking Man.

The first thing to remark [says M. de Quatrefages][1] is that not one of the creatures exhibited in this pedigree has ever been seen, either living or fossil. Their existence is based entirely upon theory.[2] All species, existing or extinct, are said to have been preceded by ancestral forms, which have

[1] *Les Emules de Darwin*, ii. 76.

[2] As an instance M. de Quatrefages cites Haeckel's own words, from his *Anthropogenie*. "The Vertebrate Ancestor No. 15, akin to the Salamanders, must have been a species of Saurian (Lizard). There remains to us no fossil relic of this animal; in no respect did he resemble any form actually existing. Nevertheless, comparative anatomy and ontogeny authorize us in affirming that he once existed. We will call this animal *Protamnion*."

disappeared leaving no vestige behind. . . . All the ancestral groups more or less ill represented in the actual organic world, do not suffice to fill up the gaps in his pedigree ; from one stage to another there is sometimes too broad a gulf. Then Haeckel invents the types themselves, as well as the line of descent to which he assigns them [for example No. 7, The *Scolecida*, and No. 21, *Pithecanthropus*].

This kind of "Science" does not deserve to be treated seriously. It will be sufficient to cite another observation of M. de Quatrefages:[1]

If Darwin erred in regarding our very ignorance as to some degree telling in favour of his notions, he never tried to re-write the missing volumes of the earth's history, to restore the chapters which have been torn out, or to fill the blanks upon pages that have come down to us. But this is just what Haeckel does continually. Whenever a branch or a twig is lacking on his genealogical trees, whenever the transit from one type to another would appear too abrupt, were we to restrict ourselves to creatures actually known, he invents species and groups bodily, to which he unhesitatingly assigns a place in phylogeny, often a part in phylogenesis. Sometimes he calls in ontogeny to countenance the discovery of supposed ancestors : but frequently he does no more than affirm their existence. He thus creates a fauna, entirely hypothetical, of which Vogt rightly said that no man ever saw a trace of it, or ever will.

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1 *Ibid.*, p. 122.

It is in this fashion that Professor Haeckel habitually solves the Riddles of the Universe.

As Vogt himself wrote,[1] "We shall be compelled to patch and alter these genealogical trees of species, which up to this time have been set forth as the last word of Science, and especially of Darwinism."

And Du Bois-Reymond,[2] "Man's pedigree, as drawn up by Haeckel, is worth about as much as is that of Homer's heroes for critical historians."

There remains to be considered Darwin's own explanation of the admitted deficiency of palæontological evidence.

> The main cause [he writes][3] of innumerable intermediate links [between different forms] not now occurring everywhere throughout nature, depends on the very process of natural selection, through which new varieties continually take the places of and supplant their parent-forms. But just in proportion as this process of extermination has acted on an enormous scale, so must the number of intermediate varieties, which have formerly existed, be truly enormous. Why then is not every geological formation and every stratum full of such intermediate links? Geology assuredly does not reveal any such finely-graduated organic chain; and this, perhaps, is the most obvious and serious objection which can be urged against the theory. The explanation lies, as I believe, in the extreme imperfection of the geological record.

1 *Revue Scientifique* (1886), p. 486.
2 *Ibid.* (1877), I. 1101.
3 *Origin of Species*, c. x.

How imperfect this record is he proceeds to argue at length, and he has no difficulty in showing how much of it has at one time or other been defaced by natural causes, and how small a portion has been laid open to our inspection. But although his demonstration on this point is continually quoted, as though it solved the difficulty, it does not appear that it need detain us long.

It is, in the first place, obvious that the absence of evidence cannot prove the truth of the theory of Evolution or any other, and it is proof of that theory which is required. Apart from palæontological facts, as Professor Huxley has told us, there can be no conclusive evidence one way or the other; and if the geological record be not sufficiently complete to supply such evidence, the theory cannot possibly claim to be scientifically established.

Is it not also, as M. de Quatrefages has remarked, very singular that precisely that evidence must be supposed always to have perished which the Evolution theory imperatively requires, while so much remains which appears to contradict it?

But, moreover, as Mr. Carruthers says, incomplete though the record undoubtedly is, and limited as is our knowledge even of what exists,—there still remains a vast mass of information which it has actually supplied, and there seems to be no reason for denying that, as to the particular point under consideration, its testimony is ample. If, as on the principles of genetic Evolution must be the case, there were in each line of descent no successive

species or genera, made up of forms clustered round one point in the course of development more than another, how comes it that we find always and everywhere just such isolated clusters, naturally forming genera and species; and that in no single instance do we find any trace of the graduated series linking them together? Is it not quite impossible to suppose, that at all points in Nature we stumble upon exactly those instances which disguise, and apparently contradict, the method upon which she invariably works?

It is likewise obvious that the practice of Evolutionists is quite inconsistent with their own plea, for their arguments are constantly unmeaning except on the assumption that the geological record is sufficiently complete for practical purposes. In the example of the Horse, for instance, which we have been considering, the whole case for his Evolution is based upon the supposition that the completed *Equus* did not exist during the earlier periods when *Eohippus*, *Anchitherium*, *Hipparion* and the rest of them were preparing the way for his appearance, and that none of these lived simultaneously with others more ancient still which are set down as *their* ancestors. But on what does such a supposition rest? Simply on the absence of remains of the more developed, in the strata containing those of the less developed. If such a reason be sufficient—which we will not question—it is likewise sufficient to establish the non-existence of intermediate forms to bridge the wide breaches in

the supposed pedigree, and we must accordingly conclude that such intermediate forms there never were.

It is no less evident that whatever further evidence is found, may tell the wrong way, from the evolutionary point of view, no less than the right one; either by discrediting supposed link-forms, or by introducing us to new and strange types which increase our difficulties by requiring lines of communication to be established with them. Thus, as Mr. Mivart tells us,[1] "It is undeniable that there are instances which appeared at first to indicate a *gradual transition*, which instances have been shown by further investigation and discovery not to indicate truly anything of the kind." Another example of the same sort is furnished by the recent discovery of *Arsinoetherium*, a genus of very large and heavy hoofed beasts, the relics of which have been recently discovered in the upper Eocene of Egypt. This creature was something like a large rhinoceros, but had no connexion whatever with that family. In fact, we are told, its horns, of which it has four, two on top of its head, and two smaller above the eyes, and also its teeth, make it stand quite apart *from all other mammals*.

It thus appears that when the theory of genetic Evolution comes to the bar of Palæontology, the most favourable verdict to which it can pretend is, Not proven.

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[1] *Genesis of Species*, p. 134.

One thing is certain. All the evidence we possess in regard of Organic Evolution, leaves the question of the origin, the propagation, and the development of life exactly where it has always been. No force has been found by Science to which we may ascribe the origin of the world we know.

As the Count de Saporta writes:[1]

Although the problem of "creation,"—formerly thought so simple, and dated almost within human ken and the period of human history—has now been relegated to a period too distant to be imagined, it would be childish to say that on that account the problem has ceased to exist. Its limits have, it is true, been shifted; but we are bound to acknowledge that they have nowise been altered. The horizon may have broadened and receded before us more and more, but the relative position of the objects we have to investigate remains precisely the same.

So too M. Blanchard:[2]

There has never been witnessed, and it is impossible to imagine the apparition of a creature not derived from another creature: it would therefore be folly to pretend to an explanation of creation. If, as the advocates of transformism suppose, all species sprang from some primitive types, or even from a single primordial cell, the appearance, whether of those types or of that parent cell of the living world, would be neither more explicable nor less marvellous than the appearance of a host of creatures.

[1] *Le monde des plantes avant l'apparition de l'homme*, p. vi.
[2] *Op. cit.*, p. 288.

And, in like manner, Darwin's great ally and admirer, Sir Charles Lyell, when he had time to realize all the bearings of his friend's theory, wrote to him,[1]—"I think the old 'creation' is almost as much required as ever."

[1] *Life of Darwin*, ii. 193.

XVIII

TO SUM UP

It is time to return to the point from which we started our whole enquiry, and to ask what has been gathered in the course of it towards a solution of the question with which we began. That the Cosmos in which we dwell, the world of law, order, and life, has not existed for ever, we saw to be a truth enforced by the researches of physical Science, no less than by the clear teaching of reason. It certainly had a beginning, and there must be a cause to which that beginning was due,—a cause capable of producing all which we find to have been actually produced. The material Universe and the mechanism of the heavens,—organic life with all its infinite marvels and varieties—animal sensation—human intelligence—canons of beauty, the law of good and evil—all these must have existed potentially in the First Cause, as in the Source whence alone they could be derived.

The Nature of this Cause was the object of our quest. In particular we set ourselves to examine the assertion now so loudly made that Science has found a full explanation in the forces of the Uni-

verse itself as they come within her cognizance, that is to say, the material forces which she can directly observe, and upon which she can experiment. In particular we have studied the Law of Evolution, in its various significations, and other laws subsidiary to it, in order to determine, from the point of view of reason and Science alone, whether it can be said that the prime factor of which we are in search is thus supplied.

The result has been to make it evident that while modern discovery has immensely multiplied and magnified the marvels which have to be accounted for, it has disclosed nothing which can be supposed to account for them in a manner to satisfy our reason. So far as the forces of Nature are concerned, the mysteries that lie beyond are even darker than they were. The origin and nature of matter and force, the source of motion, of life, of sensation and consciousness, of rational intelligence and language, of Free-will, of the reign of law and order to which all Nature testifies,—all these are for Science utterly unsolved problems, which, as some amongst her teachers tell us, must remain for ever insoluble. Even less prospect, if possible, can there be that any mechanical forces will ever account for perception of the sublime and beautiful,—and above all—of the distinction between right and wrong.

Here, then, Science stops,—confessing that she can be our guide no farther, and lending no colour whatever to the unscientific pretensions which are so noisily advanced by some persons in her name.

Her domain is the world of sense, and it is evident that nothing existing within that realm can possibly furnish an explanation which will satisfy our intellectual need for causality.

Are we therefore to say that we can know nothing concerning the First Cause to which the phenomena of the Universe are due? Such is the Agnostic's position. What we have no means of knowing, he says, we must not pretend to know. It were irrational and dishonest to do so. When Science fails us, the true wisdom is to profess ignorance, —thus only can our position still be scientific.

But is such a principle itself scientific? Is it not a gratuitous and monstrous assumption that we can know nothing but that of which our senses directly tell us? That the Universe has a cause is no less certain than that the Universe exists, for of that cause it is the monument. And, as of the whole, so of every part or element which it contains, it is absolutely certain that there must be a cause, and one adequate to the production of what has actually been produced; for as the proverb says, "Nothing is to be got out of a sack but what is in it." From such conclusions there is no escape;— and since it is impossible to find the cause required within the world of material forces and sensible phenomena, it becomes no less obvious that it must lie beyond, across the frontier which nothing material can pass.

Therefore, also, we know something concerning

that Cause,—very little, perhaps, in comparison with what we cannot know,—but still something very substantial. We know that such a Cause exists. We know that it must possess every excellence which we discover in Nature,—all that she has, and more; since what she derives from it, the Cause of Nature has of itself. In it must be all power, for except as flowing from it there is no power possible. Finally, as a capable Cause of law and order in Nature, and of Intellect and Will in man, the First Cause must be supereminently endowed with Understanding, and Freedom in the exercise of its might,—or it would be inferior to its own works.

> Since there must have been something from eternity, [says Bolingbroke][1] because there is something now, the eternal Being must be an intelligent Being, because there is intelligence now; for no man will venture to assert that non-entity can produce entity, or non-intelligence, intelligence. And such a Being must exist necessarily, whether things have been always as they are, or whether they have been made in time: because it is no more easy to conceive an infinite than a finite progression of effects without a cause.

It is therefore not easy to understand how we can avoid the conclusion of the distinguished men of Science whom we have heard declare that they assume "as absolutely self-evident" the existence

[1] *Epistle* I—to Pope.

of a Deity who is the Creator and Upholder of all things.

It will probably be answered that this is mere Anthropomorphism; which formidable term appears by many to be considered sufficient to close the whole question, and to rule the idea of a personal God out of court. Did not Voltaire remark that if in the beginning God made man to His own image and likeness, man has well repaid Him ever since? And what can be more conclusive than that?

But what—after all—does "Anthropomorphism" mean in this connexion? Simply, that being men we have to speak in human terms, even of what is superhuman. By no possibility can we do anything else. Limited as we are by the conditions of our nature, we can find no mode of expression except such as is based upon sensible experience; and although we can convince ourselves by rational inference of the existence, and to some extent of the character, of what is beyond sense, we can frame no description of it, nor even a phantasm or image by means of imagination, except so far as we are able to draw upon the phenomena of the external world. Thus it is that artists who endeavour to represent an immaterial being, as an angel, a djinn or a sprite, though the essence of the object they would depict is that it has no body, have perforce to give it one, though they make it as little gross as possible, for otherwise they could not portray it at all. But however such images may be refined

and etherealized they are intended to be understood only as conventional figures to suggest to the mind its own concept, which is as different from them as the notes produced by a singer are from those on the score from which he sings. No one imagines that the genius of Music is a young woman holding a shell to her ear, or that the Cherubim are heads and wings and nothing more. So it is with statements of the Theistic belief concerning the First Cause, or God. To put this into words we are compelled to use the only materials within our reach, and to borrow our phraseology from that which, within our experience is the highest and noblest element found in the Universe,—namely our own intelligence and will. These beyond question must be transcendentally possessed by the Cause on which they depend. So far Anthropomorphism is sound sense; that is to say, so long as it attributes all possible excellence to the source of all. It is foolish and unscientific only when it attributes to the Absolute and Unconditioned the limitations of an inferior order of being. We may truly say that a penny is contained in a pound,—but it does not follow that a sovereign must be of copper. According to the scientific doctrine that all our familiar forms of energy are ultimately derived from the Sun, it might well be argued from observation of a farthing rushlight that Solar Energy includes heat and light; but not that it is fed on tallow. This appears to be plain and obvious enough, often as

it is forgotten or ignored. As Sir Oliver Lodge has lately put the matter:[1]

Shall we possess these things and God not possess them? Let no worthy human attribute be denied to the Deity. There are many errors, but there is one truth in Anthropomorphism. Whatever worthy attribute belongs to man, be it personality or any other, its existence in the universe is thereby admitted; we can deny it no more.

Or as Professor Baden Powell expresses the same argument:[2]

That which requires thought and reason to understand must be itself thought and reason. That which mind alone can investigate or express must be itself mind. And if the highest conception attained be but partial, then the mind and reason studied is greater than the mind and reason of the student. If the more it be studied the more vast and complex is the necessary connexion in reason disclosed, then the more evident is the vast extent and compass of the intelligence thus partially manifested, and its reality, as existing in the immutably connected order of objects examined, independently of the mind of the investigator.

The reluctance frequently manifested by scientific men to admit the force of so plain an argument, appears to be generally due to a fundamental misconception. It is constantly assumed that to introduce the element of purpose in Nature is to

[1] *Hibbert Journal*, January, 1903.
[2] *Order of Nature*, p. 239.

deny the continuity of Natural law, and that to speak of design in regard of a process or a structure, is equivalent to saying that a non-natural agent intervenes at that particular point and takes the work out of Nature's hands. This, it may be supposed, was Professor Huxley's idea when he spoke of "the commoner and coarser forms of teleology," giving as an instance the supposition that eyes were constructed for the purpose of enabling their possessors to see. It might indeed be replied that, at any rate, it is less difficult to suppose this, than that eyes were constructed without any purpose of seeing, or knowledge of the laws of optics;—but evidently it is taken for granted that Theists imagine every purposive item in nature to be violently introduced from without, like the forms of lions or peacocks into which topiarian gardeners clip their shrubs. But, as has been said, the laws of Nature are the expression of the mind of God: it is through them that He accomplishes His design. As Professor Romanes came to see at the close of his life, it is strange what jealousy there is of admitting the Creator into Creation. "It is still assumed on both sides," he wrote,[1] "that there must be something inexplicable or miraculous about a phenomenon in order to its being divine,"—and although we must utterly demur to such a description of the position ot Theists, it undoubtedly is true of their adversaries. Their objections on this head can only signify that

[1] *Thoughts on Religion*, p. 123.

it is with the laws of Nature as with a railway locomotive from which the driver, having got up steam and set it going, jumps off, leaving it entirely to its own devices. But, as a legislator, if rightly interpreted, speaks by the mouth of every judge who administers the law in practice, and applies it to concrete cases,—so the Author of Nature, whose laws cannot be perverted, provides through them for all that is to be operated by the forces He has instituted.

So it is that, as Professors Stewart and Tait have told us, we must conceive of Him as not the Creator only, but likewise the Upholder of all things, while Lord Kelvin declares [1] we are unmistakably shown through Nature that she depends upon one "ever-acting Creator and Ruler." It is in this omnipresence of Divine influence that Monism finds the modicum of plausibility which serves it for a foundation. It runs, indeed, into the absurdity of endeavouring to explain such Omnipresence by identifying the finite with the Infinite, and attributing to matter qualities which all experience, and very specially all scientific experience, contradicts; but, for all that, it scores a distinct point as against mere materialism, which Comte declares to be "the most illogical form of metaphysics," and the late Sir Leslie Stephen, "not so much error as sheer nonsense." Theism avoids the error of either extreme. While it teaches the essential and fundamental distinction

[1] *Presidential Address*, British Association, 1871.

between the Absolute and the contingent, between the Creator and His creatures, it teaches likewise that He is ever present in His works, and that in their every operation He is manifested.

And so, in the words of Rivarol, God is the explanation of the world, and the world is the demonstration of God. The acceptance of a Self-existent, All-powerful, and intelligent Being can alone serve as a basis for any system of Cosmogony which satisfies our intellectual need of causation; while, on the other hand, the nature of this Being, as necessarily beyond the scope of our senses, can be known to us only indirectly through the effects of which He is the cause.

By no one has this conclusion been more clearly stated than by Lamarck, the real father of Organic Evolutionism, whom many would therefore represent as an atheist. His words are so much to the point that with them we may conclude.[1]

> Of the Supreme Being, in a word of God, to whom all infinitude is seen to belong, man has thus conceived an idea, which, though indirect, is sound, and which necessarily follows from what he observes. In the same manner, he has formed another idea, equally solid, namely of the boundless power of this Being, suggested by the consideration of His works. . . .
>
> Nature not being intelligent, nor even a being, but an order of things constituting a power subject to law,

[1] *Système Analytique des Connaissances positives de l'homme* (1830), pp. 8, 43.

cannot therefore be God. She is the wondrous product of His Almighty will: and for us, of all created things she is the grandest and most admirable. Thus the will of God is everywhere expressed by the laws of Nature, since these laws originate from Him.

APPENDIX

A. Note on Chap. XV. p. 203.

SINCE the foregoing pages have been in type there has come to hand the New York *Literary Digest* of January 23, 1904, containing the following article (p. 119).

"ARE THE DAYS OF DARWINISM NUMBERED?"

The recent death of Herbert Spencer lends special timeliness to the above topic, which is being actively debated just now in German theological circles. The immediate cause of the revival of interest in the present status of the Darwinian theory is found in a lengthy article by the veteran philosopher, Edward von Hartmann, which appears in Oswald's *Annalen der Naturphilosophie* (vol. ii. 1903), under the title 'Der Niedergang der Darwinismus' ('The Passing of Darwinism'). That the famous 'philosopher of the unconscious' is not prejudiced in favour of biblical views has been more than clear since the publication of his *Selbstzersetzung der Christentums* ('Disintegration of Christianity') in 1874. Hartmann in his new article has this to say—

'In the sixties of the past century the opposition of the older group of savants to the Darwinian hypothesis was still supreme. In the seventies, the new idea began to gain ground rapidly in all cultured countries. In the eighties, Darwin's influence was at its height, and exercised an almost absolute control over technical research. In the nineties, for the first time, a few timid

expressions of doubt and opposition were heard, and these gradually swelled into a great chorus of voices, aiming at the overthrow of the Darwinian theory. In the first decade of the twentieth century it has become apparent that the days of Darwinism are numbered. Among its latest opponents are such savants as Eimer, Gustav Wolf, De Vries, Hoocke, von Wellstein, Fleischmann, Reinke, and many others.'

These facts, according to Hartmann's view, while they do not indicate that the Darwinian theory is doomed, undermine its most radical features:

'The theory of descent is safe, but Darwinism has been weighed and found wanting. Selection can in general not achieve any positive results, but only negative effects; the origin of species by minimal changes is possible, but has not been demonstrated. The pretensions of Darwinism as a pure mechanical explanation of results that show purpose are totally groundless.'

Other scholars think that Hartmann does not do full justice to the reaction that has set in, particularly in Germany, against Darwinism. This sentiment is voiced by Professor Zoeckler, of the University of Greifswald, in the *Beweis des Glaubens* (No. xi.), a journal which recently published a collection of anti-Darwinian views from German naturalists. He calls the article of Hartmann 'the tombstone-inscription [*Grabschrift*] for Darwinism,' and goes on to say:

'The claim that the hypothesis of descent is secured scientifically must most decidedly be denied. Neither Hartmann's exposition nor the authorities he cites have the force of moral conviction for the claim for purely mechanical descent. The descent of organisms is not a scientifically demonstrated proposition, although descent in an ideal sense can be made to harmonize with the biblical account of creation.'

Views of a similar kind are voiced in many quarters. The Hamburg savant, Edward Hoppe, has written a

brochure, *Ist mit der Descendenz-Theorie eine religiöse Vorstellung vereinbar?* [Is the Theory of Evolution reconcilable with the Religious Idea?] in which he takes issue, in the name of religion, with the purely naturalistic type of Darwinian thought. The most pronounced convert to anti-Darwinian views is Professor Fleischmann, of Erlangen, who has not only discarded the mechanical conception of the origin of being, but the whole Darwinian theory. He recently delivered a course of lectures, entitled 'Die Darwin'sche Theorie,' which have appeared in book form in Leipsic. He comes to this conclusion: 'The Darwinian theory of descent has not a single fact to confirm it in the realm of nature. It is not the result of scientific research, but purely the product of the imagination.'

From another article in the same journal (p. 116), entitled 'A Study of Creation,' the following paragraphs may be cited:

"The French have never been enthusiastic Darwinians. It is, perhaps, not surprising, therefore, to find a French geologist, M. Stanislas Meunier, arguing in the *Revue Scientifique* (December 19) against all schools of transformism and stoutly maintaining what is practically a doctrine of special creation. He admits that living beings form a connected series; but the connexion, he believes, is not one of physical descent, but inheres in something outside of and pre-existent to the earth. He does not name it, but he would probably not object to the inference that it is the mind of a creator.

"M. Meunier gives at some length his reasons for rejecting Darwin's, Lamarck's, and all other theories of transformism. All we can be sure of, he thinks, is that, as in the case of the various kinds of pottery, we have to do with an orderly development, although he thinks it is not a development by descent. He closes, thus:

"'Doubtless we cannot usefully risk any hypothesis on the mechanism of the production of living things; but it is, perhaps, a step in advance only to come to the conclusion that the cause of life and its manifestations on the earth is exterior to the earth; that it is anterior to our world, just as are doubtless the laws of physics and chemistry, which govern the relations of matter and force throughout space.

"'The philosophy of science can lose nothing by the admission of points of view that, far from narrowing our subjects of study, enlarge them beyond all limits; and this is, perhaps, the occasion to show once more to persons who are turning toward metaphysics in their thirst for mystery, that they will find in pure science that wherewith they may satisfy their legitimate aspirations.'"

B. Succession of Plant forms, p. 220.

Recent investigations have led to the remarkable discovery that many fern-like plants of the Carboniferous rocks, hitherto classed as Cryptogams, were in reality seed-bearers, and thus intermediate between Cryptogams and Cycads, the most primitive of existing seed-plants. They have accordingly been placed in a special group "Cycadofilices," or "Fern-Cycads," and regarded as transitional types, the view that they are the remains of a natural bridge connecting the Ferns with the Gymnosperms having received wide support,[1] and at first sight this conclusion would appear natural and obvious. But here, as in other cases, the difficulty is that the seeds which have been found are all fully developed; there are none in the intermediate stages between true spores and true seeds; we have the finished article, but no trace of seeds in the making; which upon any theory of evolution must have been exceedingly numerous. Hence Dr. Scott tells us:[2]

"The important discoveries of the seeds of the Pterido-

[1] See *Nature*, June 4, 1903, p. 113, in notice of a paper on the subject by Professor F. W. Oliver and Dr. D. H. Scott, F.R.S.

[2] *Linnean Society's Proceedings*, May 3, 1906.

sperms scarcely touch the question of descent, for these organs are of too advanced a type to throw light on the probable derivation of the group."

In this instance, therefore, as in others, it remains true that in no case is any trace found of rudimentary character in the earliest fossil specimens of any class.

It is undoubtedly a further puzzle that some of the Carboniferous cryptogams which did not bear real seeds, yet simulated them, a habit not easily explained on evolutionary principles.

C. *The Course of Evolution.*

The evidence of Professor Vines quoted in the text (pp. 202, 237) receives a remarkable confirmation from that of Dr. Smith Woodward, Keeper of Geology in the National Museum of Natural History. Speaking before the International Congress of Arts and Science, St. Louis, U.S.A., September 22nd, 1904, he thus touched upon the same question, which he illustrated especially from the history of fossil fishes, which he has made his special study.[1]

"It must be confessed that repeated discoveries have now left faint hope that exact and gradual links will ever be forthcoming between most of the families and genera. The 'imperfection of the record,' of course, may still render some of the negative evidence untrustworthy; but even approximate links would be much commoner in collections than they actually are if the doctrine of gradual evolution were correct. Palæontology, indeed, is clearly in favour of the theory of discontinuous mutation, or advance by sudden changes, which has lately received so much support from the botanical experiments of H. de Vries.

"Further results obtained from the study of fossils have a bearing even on the deepest problems of Biology, namely, those connected with the nature of life itself. For instance, it is allowable to infer, from the statements already made, that the main factor in the evolution of organisms is some inherent impulse—the 'bathmic force' of Cope—which acts with unerring certainty whatever be the conditions of the moment."

[1] See the *Congress Report*, vol. iv.

D. *Pedigree of the Horse.*

Some recent evidence on this subject certainly does not clear away the difficulties set forth in the text.

From *Nature*, Sept. 8, 1904, p. 474.

"Professor Osborn (in a lecture before the British Association) mentioned that more than a hundred more or less complete skeletons of horses and horse-like animals had been found in North America. He thought he had established the fact that horses were polyphyletic, there being four or five contemporary series in the Miocene, but that the direct origin of the genus *Equus* in North America was not established with certainty."

Professor Sedgwick, *Student's Text Book of Zoology*, p. 599.

"Much has been written on the ancestry of the horse. It has been maintained by many authors that a continuous series of forms connecting it with the four-toed, brachyodont Hyracothoridæ of the Eocene has been discovered, and that here if anywhere a demonstrative historical proof has been obtained of the doctrine of organic evolution. Without desiring in the smallest degree to impugn that doctrine, it may be permitted us here to examine rather closely the view that the series of forms which recent palæontological research has undoubtedly brought to light constitute that historical proof which has been claimed for them."

[After an examination of the structural characters of these intermediate forms, viz., *Pliohippus*, *Protohippus*, *Desmathippus*, *Miohippus*, *Mesohippus*, *Orohippus*, and *Hyracotherium*, the author proceeds]:

"So far as the characters mentioned are concerned, we have here a very remarkable series of forms which at first sight seem to constitute a linear series with no cross-connections. Whether, however, they really do this is a difficult point to decide. There are flaws in the chain of evidence, which require careful and detailed consideration. For instance, the genus *Equus* appears in the Upper Siwalik beds, which have been ascribed to the Miocene age. It

has, however, been maintained that these beds are in reality Lower Pliocene, or even Upper Pliocene. It is clear that the decision of this question is of the utmost importance. If *Equus* really existed in the Upper Miocene, it was antecedent to some of its supposed ancestors. Again in the series of equine forms, *Mesohippus*, *Miohippus*, *Desmathippus*, *Protohippus*, which are generally regarded as coming into the direct line of equine descent, Scott[1] points out that each genus is, in some respect or other, less modified than its predecessor. In other words, it would appear that in this succession of North American forms the earlier genera show, in some points, closer resemblance to the modern *Equus* than to their immediate successors. It is possible that these difficulties and others of the same kind will be overcome with the growth of knowledge, but it is necessary to take note of them, for in the search after truth nothing is gained by ignoring such apparent discrepancies between theory and fact."

Besides the structure of limbs and teeth, another argument for the descent of the horse has been drawn from certain phenomena of colouration. Stripings are found not unfrequently to occur in the legs and withers, which Darwin took for a reversion to the character of a very remote ancestor, the common parent, in fact, of horses and asses, which he supposed to have been striped all over like a zebra. Like other such common ancestors, this hypothetical animal had never been seen, but was thought to be most nearly represented by the Kathiwar horse, with stripes on a dun ground, a specimen of which is exhibited as illustrating the hypothesis in the National Museum of Zoology.

Recently, however, Professor Ridgeway, who has devoted special attention to the problem, has satisfied himself that there is no sufficient foundation for these suppositions. He thus sums up the evidence which he has been able to collect:[2]

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[1] *Transactions American Philosophical Society* (N.S.), 18, 1896, pp. 119, 120.

[2] *The Origin and Influence of the Thorough-bred Horse.* Cambridge, 1905.

"Darwin's view that the original ancestor of the Equidæ was a dun-coloured animal, striped all over, was based, not merely on the occurrence of stripes in horses, but on his belief that such stripes were common in dun horses, and that there was a tendency in horses to revert to dun colour. But it must be confessed that the facts do not warrant his conclusion. . . . It is clear that stripes are at least as often a concomitant of dark as of dun colour. Moreover, if Darwin's hypothesis of a dun-coloured ancestor with stripes is sound, dark colours such as bay and brown must be of more recent origin, and accordingly there ought to be a great readiness on the part of a progeny of a light-coloured animal when mated with a dark to revert to the light. But Professor Ewart's zebra stallion has never been able to stamp his own peculiar pattern or his own colours on his hybrid offspring. The ground colour has been determined by the dams of the hybrids."

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